

CDM

Report

Michigan Department of Environmental Quality
Long Term Monitoring Program Results from the 2000 Field Season
Allied Paper, Inc./Portage Creek/ Kalamazoo River Superfund Site

January 2002

CDM Camp Dresser & McKee

Michigan Department of Environmental Quality

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Section 1

Introduction

In 1998, the Michigan Department of Environmental Quality (MDEQ), with assistance from their contractor, Camp Dresser & McKee (CDM) implemented a long-term monitoring program for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site (Site) in southwestern Michigan. CDM prepared a Long Term Monitoring Plan (CDM, 1999) describing sampling locations, parameters to be measured, and chemical analyses to be conducted for the first year of the Long-Term Program (i.e. 1999). The major objectives of this program are to 1) develop a baseline data set for polychlorinated biphenyl (PCBs) concentrations in surface water and fish tissue from individual reaches of the river prior to remediation activities at the site; 2) to evaluate the effectiveness of remediation activities with post remediation sampling and, 3) to investigate the utility of caged catfish and semipermeable membrane devices (SPMDs) as short-term, location specific sampling devices for measuring bioavailable PCBs.

The initial data collection of the Long Term Monitoring (LTM) Program may have been influenced by remediation activities occurring in the Bryant Mill Pond area of Portage Creek, adjacent landfills and former lagoons along the river. In addition, future remediation activities may occur during the collection of the baseline data. However, this should have a minor influence on the LTM program.

Although no specific sampling plan was used for year 2000, this study follows the protocols and locations for the sampling plan in 1999. This report documents the results from

sampling conducted in 2000, and briefly discusses plans for 2001.

Baseline data sets will consist of data collected during 1999 to 2001, as well as in subsequent years (2002 to 2003). Data from each year will be presented in an annual report. Sampling years 1999 and 2000 data will not be subject to rigorous statistical evaluation in the annual reports, but will be



evaluated at the end of 2001. The results from the year 2001 sampling program will be used to help refine future monitoring efforts in the study area.

Figure 1-1. A-Site along the Kalamazoo River.

Section 2

Methodology and Rationale

2.1 Sampling Location Selection

In this study, resident fish and surface water samples were collected and analyzed for PCBs. In addition, hatchery raised yearling catfish were placed in cages and deployed along with SPMDs. These were also analyzed for PCBs. Abiotic (water) and biotic (fish tissue) samples were collected from reaches of the river where remediation has occurred or will occur to eliminate unacceptable risk. The number of sampling locations for various matrices (e. g. resident fish) were reduced from those sampled in 1999 to focus on those areas where remediation is expected in the near future. All other locations will be sampled again in 2001 and 2003.

Priorities for sampling locations included bracketing PCB source areas such as current



Figure 2-1. Sampling from Lake Allegan Dam

and former impoundments, landfills, floodplain sediment deposits, etc. to evaluate the effectiveness of remediation activity at or from a particular reach of the river. Other locations included established background conditions upstream of known PCB sources.

To a lesser extent, locations chosen were historically sampled in previous studies, to evaluate trends in PCB concentrations, or to supplement the existing database for areas that may be remediated.

2.2 Sample Collection Methods

The sample collection methods used in the year 2000 sampling event are described in the standard operating procedure documents in Appendices A through E in the Final Long-Term Monitoring Plan (CDM, 1999).

2.2.1 Surface Water

Surface water was collected for three different studies: Dry weather (base flow), wet weather ("rising" and "falling" limb) and during the caged catfish study. Collection of surface water is necessary to document the distribution of PCBs in water during dry and wet weather conditions. Surface water was collected (Figure 2-1) to document the distribution of PCBs for each week of the four weeks of the caged catfish study (Section 2.2.3). Since sediments (instream and floodplain) are continuously entrained in and deposited from the water column, causing redistribution of PCBs in the riverine system, surface water samples were also analyzed for total suspended solids (TSS).

Surface water samples were collected directly in 1-liter amber glass sample bottles. The bottles were lowered into the surface water using a metal harness attached to a rope. The bottles were raised up and down through the water column to collect a depth-integrated sample. Samples were stored on ice in the field or at 4° C until extraction.

Dry weather water samples were generally collected at base flow conditions in the

Kalamazoo River and (800–1000 cubic feet/second) and Portage Creek (20–40 cfs). Wet weather samples were collected during or just after a significant precipitation event (+/- .5 inches) that resulted in a flow rate increase of the Kalamazoo River (rising limb). Flow was observed by monitoring Kalamazoo River hydrographs on the Real-Time Data USGS Web Site (water.usgs.gov/mi/nwis/current). Once the hydrograph indicated flow had peaked and was decreasing in flow, a second sample was collected (falling limb).

2.2.2 Resident Fish

Fish anglers, both recreational and subsistence, may be exposed to significant levels of PCBs via ingestion of fish taken from contaminated reaches of the river. In many assessments of PCB contamination in river systems, consumption of contaminated fish has resulted in the highest estimates of exposure and health risk. Carp (*Cyprinus carpio*) were targeted since they are bottom dwelling fish that may be exposed to PCBs in sediments, and smallmouth bass (*Micropterus dolomieu*) were collected as they represent sport fish. In addition to collecting adult smallmouth bass, yearling smallmouth bass were collected at each location to represent first year exposure to PCBs. Adult resident fish were analyzed for total PCBs and lipid content, while yearling smallmouth bass were analyzed for PCB congeners and tissue lipid content. PCB congeners were analyzed in yearling smallmouth bass to potentially identify additional sources of PCB loadings into the river after remediation.

Adult carp, adult smallmouth bass, and yearling smallmouth bass, were collected by electrofishing techniques. Samples were collected under the Michigan Department of Natural Resources Fisheries Division collector's permit number BO247. Other game fish (e. g. walleye, northern pike) or bottom dwelling fish (e. g. channel catfish) were



Figure 2-2. Electroshocking in Portage Creek

collected while electroshocking, if available (Figure 2-2). Fish length and weight were recorded in the field from reaches of the river listed in Table 2.1. Adult fish were individually wrapped in plastic, and yearling smallmouth bass were combined into composite samples of 40 to 60 grams each (usually 5 fish). All samples were stored on ice in the field and frozen until processing. Details of procedures were the same as those outlined in Appendix B, Final LTM Plan, September 1999.

The yearling smallmouth bass composite samples were shipped directly to the Northeast Analytical laboratory (NEA) for processing (grinding and homogenization) and analysis. MDEQ staff filleted the adult fish as per MDEQ-Surface Water Quality Division Great Lakes Environmental Assessment Section (GLEAS) Procedure #31, and stored the fillets until processing and analysis by NEA. Fish were submitted under a chain-of-custody (COC) to NEA. While processing fish for PCB analyses, sex of adult fish was noted, and selected body parts were taken to age the fish. To age carp, opercles (gill covers) and dorsal spines were removed. For adult smallmouth bass, scales behind the pectoral fin and below the lateral line were collected. Otoliths were extracted from five carp to verify aging techniques.

2.2.3 Caged Fish and Semi-Permeable Membrane Device Study

In order to identify a cost effective method to monitor PCB movement in the Kalamazoo River and Portage Creek, caged fish and SMPDs were used to determine which technique would provide an accurate measurement of PCBs for monitoring remediation. The results from these two sampling methods will be compared after the 2001 Long Term Monitoring program to select one method for measuring PCBs in future monitoring programs.

Caged young-of-the-year channel catfish (*Ictalurus punctatus*) are routinely used by the MDEQ and others as indicators of bioavailable contaminant concentrations. Caged fish are superior to mobile resident fish as indicators of site-specific contaminant concentrations. Channel catfish are used rather than other species such as fathead minnows (*Pimephales promelas*) because catfish are more tolerant of poor water quality conditions.



Figure 2-3. Caged catfish and SMPD cages.

The caged fish study (Figure 2-3) was conducted as per the MDEQ GLEAS Procedure #62. Four cage replicates with approximately 50 grams of fish tissue were placed at five stations for 28 days. These were combined into 4 whole-fish composite samples for analysis. At the beginning of the study, a group of 4 whole-fish composite samples not deployed at any of

the locations were sacrificed and used as a control group. Caged fish were analyzed for PCB congeners, and the fish tissues were analyzed for total lipids. Details of procedures are the same as those outlined in Appendix D, Final LTM Plan, September, 1999.

SPMDs are a polyethylene membrane packet containing a small amount of triglyceride lipid, triolein. SPMDs, accumulate hydrophobic contaminants (such as PCBs) by passive diffusion, similar to many aquatic organisms, and have been used as surrogates for fish in a variety of studies. SPMDs are particularly useful for determining site-specific concentrations of bioavailable contaminants in locations where aquatic organisms may not survive. PCB data from caged catfish and SPMDs were assessed for comparability to each other and to other sampling media.

A stainless steel tubular cage containing 3 SPMDs was placed at each station for 28 days. The SPMD cage was attached to the fish cage to maximize the comparability of these two sample types. Each SPMD was dialyzed into hexane and analyzed individually. Details of procedures are the same as those outlined in Appendix E, Final LTM Plan, September 1999.

2.2.4 Bedded Sediment

Bedded sediments were collected to evaluate PCB concentrations in the upper portions of the sediment bed to determine sediment partition coefficients for ecological risks. Bedded sediment, from the upper 2-inch layer of sediment deposited on the river bed, was collected. Bedded sediments at this depth are considered to be biologically active. Resident fish may feed on organisms living within this layer, and/or fish may use sediment areas to spawn or nest. PCB congeners found in the sediment were compared with PCB congeners in the resident fish to assess uptake of PCBs from the sediment to fish.

Bedded sediment samples were collected from three of the resident fish sampling locations in stream reaches at near-shore areas where resident fish were electroshocked. A 2-inch diameter cellulose acetate butyrate plastic core tube was pushed into the sediment by hand or by pounding on the upper end of the tube with a core pounder. When the tube would no longer penetrate the substrate, it was carefully withdrawn and capped at the bottom and top, transported to shore, and the upper 2 inches of sediment removed with a stainless steel spatula. If multiple cores were collected, the upper 2-inch sections from each core were homogenized in a stainless steel bowl. The sample was stored in a wide-mouth glass bottle on ice or frozen until analysis. Details of procedures are the same as those outlined in Appendix C, Final LTM Plan, September 1999.

2.2.5 Fish Aging

The aging of fish requires the collection of certain parts of the fish. They include scales, dorsal spines, otoliths (earstones) and operculum bones. These structures contain bands (annuli) that delineate seasonal growth, and these growth rings are counted to estimate age. The primary methods used for fish collected in 2000 include scales on smallmouth bass and the operculum bone of the carp.

Adult smallmouth bass and common carp were aged to establish a mechanism by which fish could be aged in the field without going through time consuming aging techniques (i.e. counting annular growth rings on fish scales, otoliths). Additionally, the aging data was used to evaluate potential relationships between the concentration of total PCBs in fish versus age, length, weight and lipid content.

Fish aging was conducted by Dr. David Jude (Great Lakes and Aquatic Sciences- LSA, University of Michigan) and aging was verified by David Swank (Institute of Fisheries

Research-University of Michigan). Both of the individuals conducted the aging and verification as private consultants to CDM. Fish aging procedures outlined by the American Fisheries Society and are summarized as follows:

Fish Scales

Scales from smallmouth bass were taken from the middle region of the side of the body, just below the lateral line. Aging was done with raw scales, mounted between two glass slides and examined under a microscope. Scale features used to aging fish are the circuli on the scale. Circuli are laid down in a circular pattern on the scale, and several circuli are added to the scale each year. The outer edge of a group of closely spaced circuli indicates the termination of a year's growth (Nielsen, et. al. 1985). This region is typically called the annulus, and the fish age is calculated by counting the number of annuli (Figure 2-4).

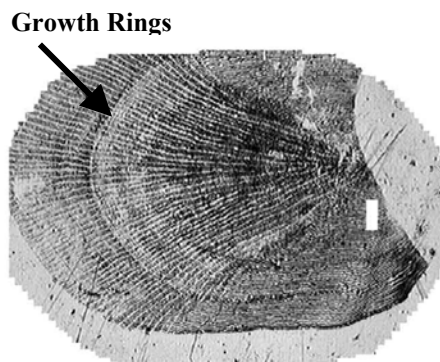


Figure 2-4. Fish Scale

Operculum Bones

Operculum bones were collected from carp to aid in the age investigation. Operculum bones cover the gill chamber in bony fish and have similar growth patterns (annular rings) as scales. The annular rings on the operculum bone are counted using a dissecting microscope. The total number of annular rings provides an estimate of the fish's age.

2.3 Sample Analysis Methods

Table 2.2 lists the analytical methods used in this study.

PCB analyses for yearling smallmouth bass and surface water samples were congener-specific, using high-resolution capillary gas chromatography. This procedure provides lower detection limits than the Aroclor analyses conducted in earlier studies on the Kalamazoo River.

Congener-specific PCB analyses produce several lines of data for each sample. Figures and data tables presented in Section 3



Figure 2-5. Analyst at GC Mass Spec

summarize the total PCB data of the congeners. Laboratory data sheet results for congener results are contained in Appendices A through M.

Adult carp and smallmouth bass, and caged catfish samples were analyzed for PCBs by Aroclor, and the results for these total PCB analyses are also summarized. Complete information on Aroclors from fish analyses are in Appendix N.

2.4 Sample Heterogeneity

Multiple samples were generally collected at each sampling location in the 2000 surveys; e. g. three water samples across a transect at each dry weather water sampling location, four composite channel catfish samples at each cage study location, etc. Data heterogeneity was assessed by calculating a relative standard deviation (RSD) value.

In the context of replicate samples, a low RSD value is traditionally interpreted as indicating the mean of the replicates is an acceptable, representative expression of the parameter value at that time and location. Although an RSD of 20% is generally considered an acceptable value for laboratory-generated replicate samples, there is no generally accepted criteria for the RSD of field samples. For the purpose of this report, an RSD of 30% for field samples will be considered “low”.

2.5 Quality Assurance, Quality Control, and Data Validation

2.5.1 Data Usage

The data obtained in 2000 LTM, are to be used to supplement 1999 and subsequent data to establish baseline or pre-remedial PCB concentrations. Baseline surface water data will be used to evaluate seasonal and temporal variations in water column PCB concentrations.

2.5.2 Quality Assurance Objectives

The project specific quality assurance objectives for the 2000 Long Term monitoring are described in Section 4.4 of the Long Term Monitoring Plan (September 1999). As per this plan, field quality control samples were collected to evaluate precision and accuracy. For surface water samples, field duplicates were to be collected at a frequency of one per survey. For bedded sediment, field duplicates were to be collected at a frequency of one per every ten

samples. The relative percent difference (RPD) for field duplicates was considered acceptable if it was less than 25%.

The guideline of 25% relative percent difference for field duplicates is a guideline, not a control limit. The comparison of field duplicates is used to indicate possible problems with field sampling techniques or sample handling. Sampling techniques that do not lend themselves to a single collection and subsequent splitting often do not have good field duplicate agreement. For solid matrices, the non-homogeneous nature of the matrix often causes field duplicates to exceed the 25% RPD guideline. Additionally, at very low contaminant concentrations such as those in some of the surface water samples for this site, field duplicates will have poor agreement due to non-detections or low detections that are at the low end of the instrument calibration where there is more uncertainty in the concentration values reported. Therefore, the field duplicate information is used to evaluate sample handling and sampling techniques only. No data were qualified based on field duplicate agreement exceeding the 25% RPD guideline.

Surface water and bedded sediment matrix spike/matrix spike duplicates (MS/MSD) were to be collected at a frequency of one per 20 samples. For surface water and sediment, a triple sample volume is collected in the field to ensure sufficient volume of sample for the MS/MSD analysis in the laboratory. Samples for MS/MSD analysis are to be clearly marked on the field COC form for easy identification by the laboratory. The laboratory also performed MS/MSD analysis for fish samples at a frequency of one per 20 samples. However, additional sample volume is not required and fish MS/MSD samples are selected in the laboratory rather than in the field. Field blanks or equipment/rinsate blanks were to be

collected at a frequency of one per every ten surface water or bedded sediment samples.

The laboratory quality control criteria for this 2000 sampling event are defined as follows: Laboratory check standards were required to fall within 15% of the true value of the standard to be considered in control or to meet the QC criteria. Laboratory blank samples that have a total PCB concentration greater than the practical quantitation limit (PQL) are reviewed to determine if the concentration of any individual Aroclors or congeners exceed the PQL. Data will only be qualified for blank contamination if individual Aroclors or congeners exceed the PQL. Matrix spike and matrix spike duplicate sample recoveries were required to fall within the range of 60% to 140% of the true spiked value. The agreement between MS and the MSD were required to be within 25% RPD to be considered in control. The first laboratory surrogate was required to have a surrogate recovery within the range of 60% to 140% and if it did not meet that criteria, an additional surrogate analysis would be performed which would then need to fall within those control limits.

Surface Water

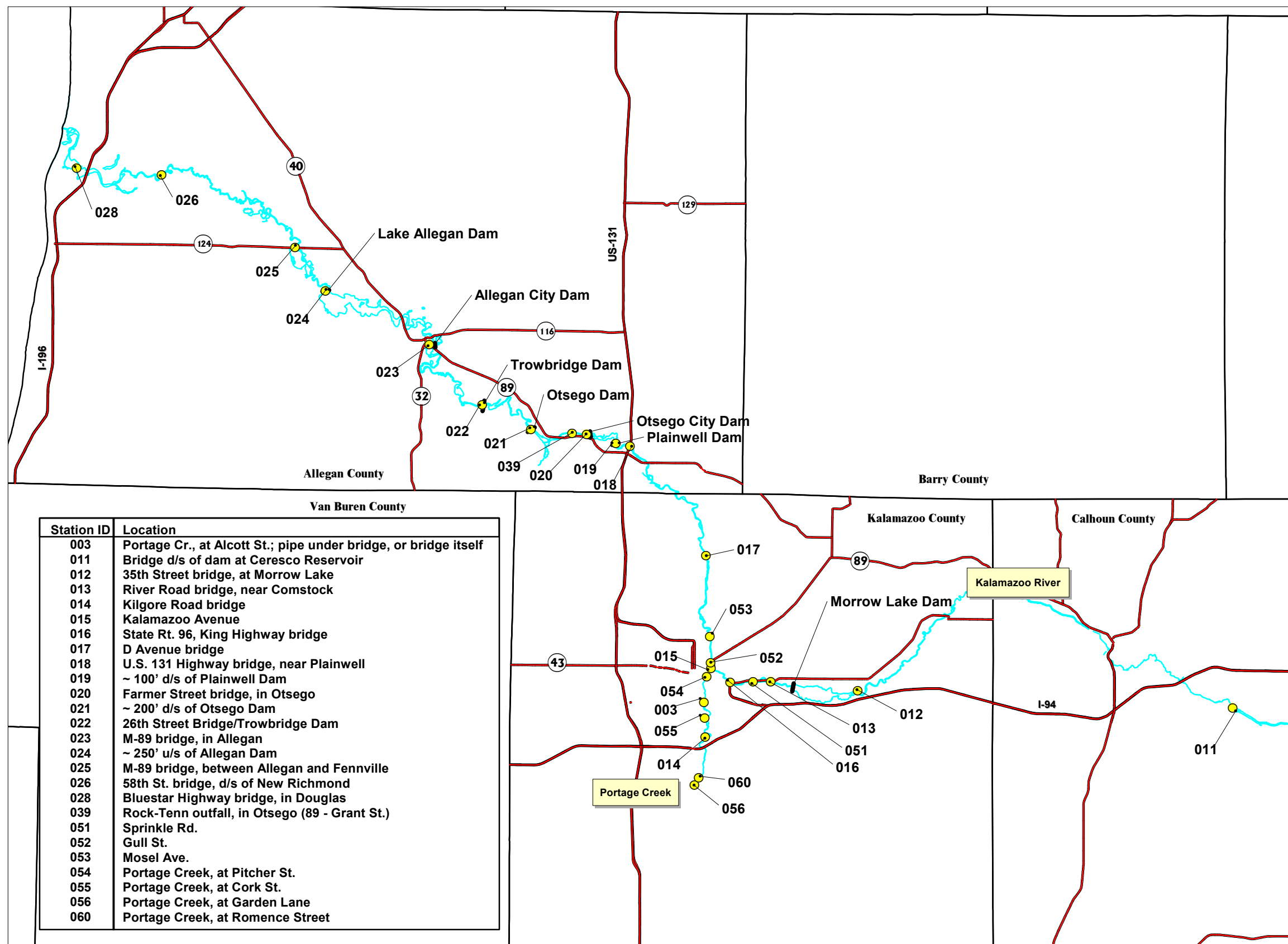
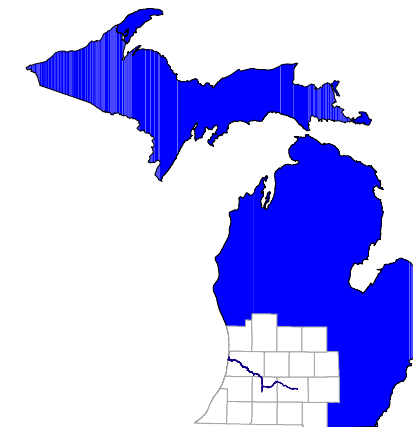
Dry Weather

Wet Weather

Dry Weather

Figures

Tables



Station ID	Location
003	Portage Cr., at Alcott St.; pipe under bridge, or bridge itself
011	Bridge d/s of dam at Ceresco Reservoir
012	35th Street bridge, at Morrow Lake
013	River Road bridge, near Comstock
014	Kilgore Road bridge
015	Kalamazoo Avenue
016	State Rt. 96, King Highway bridge
017	D Avenue bridge
018	U.S. 131 Highway bridge, near Plainwell
019	~ 100' d/s of Plainwell Dam
020	Farmer Street bridge, in Otsego
021	~ 200' d/s of Otsego Dam
022	26th Street Bridge/Trowbridge Dam
023	M-89 bridge, in Allegan
024	~ 250' u/s of Allegan Dam
025	M-89 bridge, between Allegan and Fennville
026	58th St. bridge, d/s of New Richmond
028	Bluestar Highway bridge, in Douglas
039	Rock-Tenn outfall, in Otsego (89 - Grant St.)
051	Sprinkle Rd.
052	Gull St.
053	Mosel Ave.
054	Portage Creek, at Pitcher St.
055	Portage Creek, at Cork St.
056	Portage Creek, at Garden Lane
060	Portage Creek, at Romence Street

LEGEND

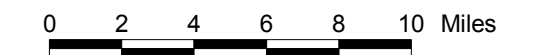
Dry Weather Stations

Dams

Highways

County Boundaries

Portage Creek / Kalamazoo River



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Updated:
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Allied Paper, Inc./Portage Creek/
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Long Term Monitoring - 2000
Dry Weather Sampling Locations

Figure No.
3-1

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Figure 3.2. Total PCBs (Congeners) in Dry Weather Surface Water Samples, Kalamazoo River, Event 1 (July 25 and 26, 2000) (no bars = non-detect PCBs)

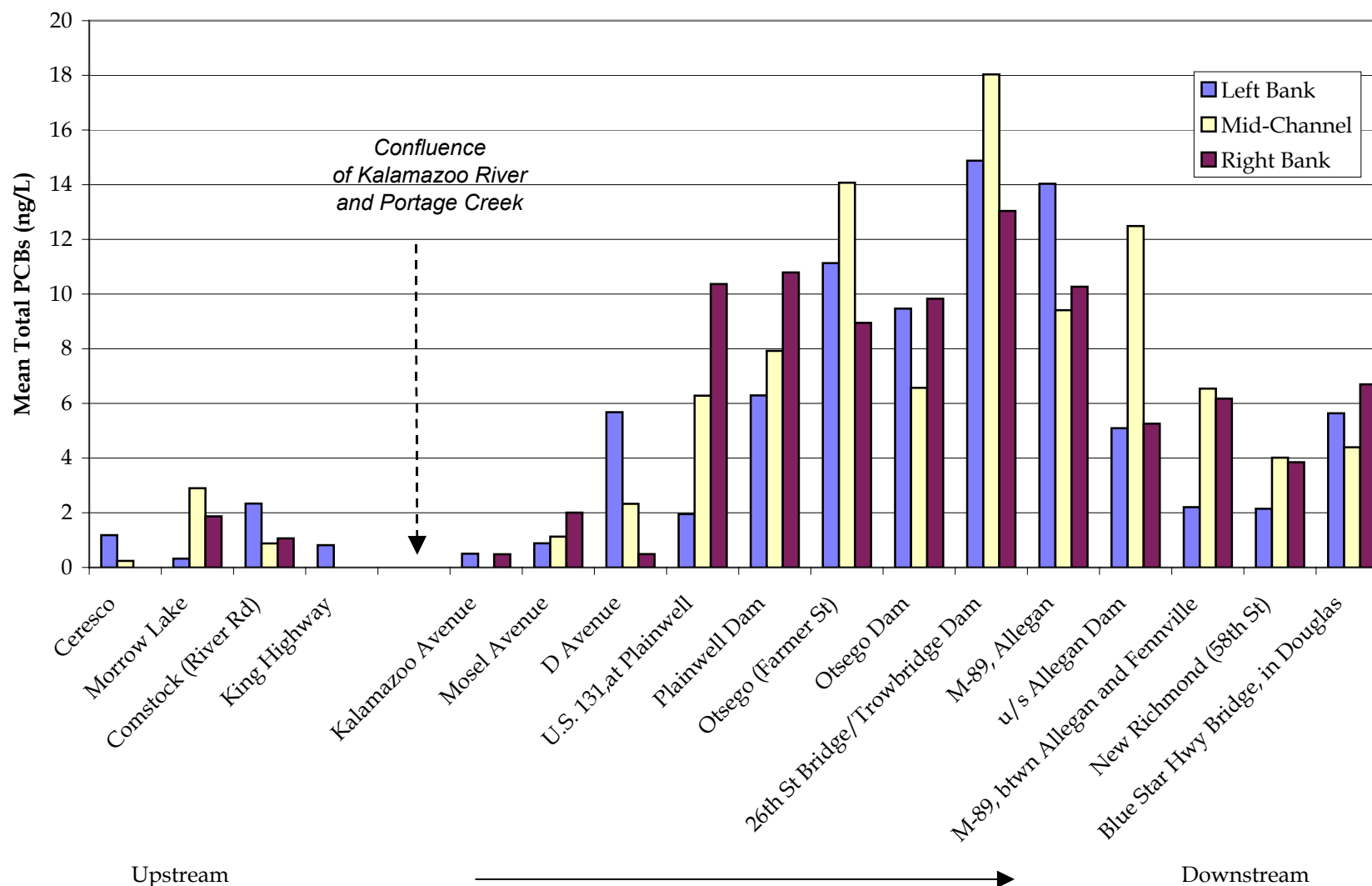


Figure 3.3. Total PCBs (Congeners) in Dry Weather Surface Water Samples, Portage Creek,
Event 1 (July 25 and 26, 2000) (no bars = non-detect PCBs)

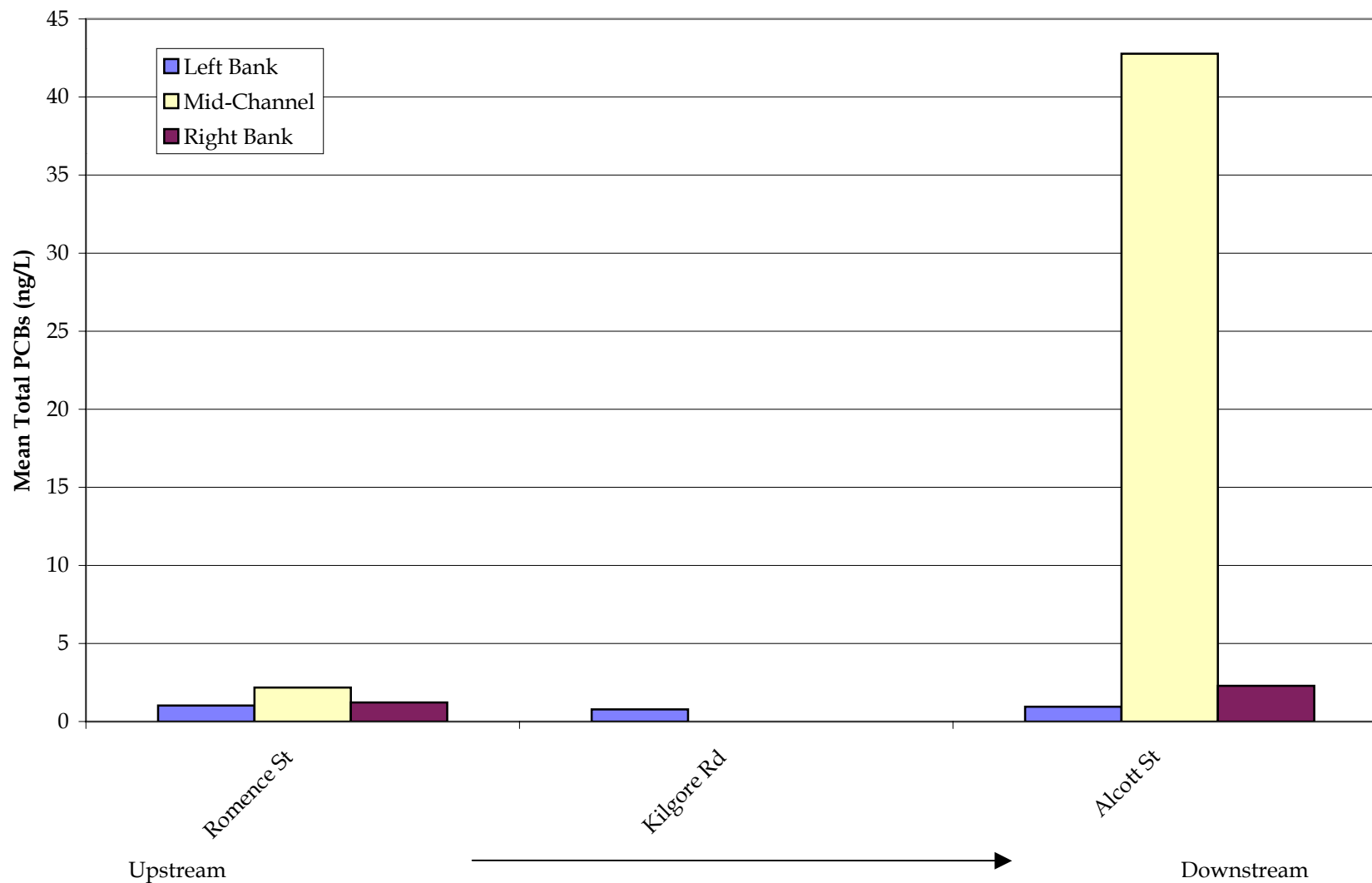


Figure 3.4. Total PCBs (Congeners) in Dry Weather Surface Water Samples, Kalamazoo River, Event 2 (October 17 to 22, 2000) (no bars = non-detect PCBs)

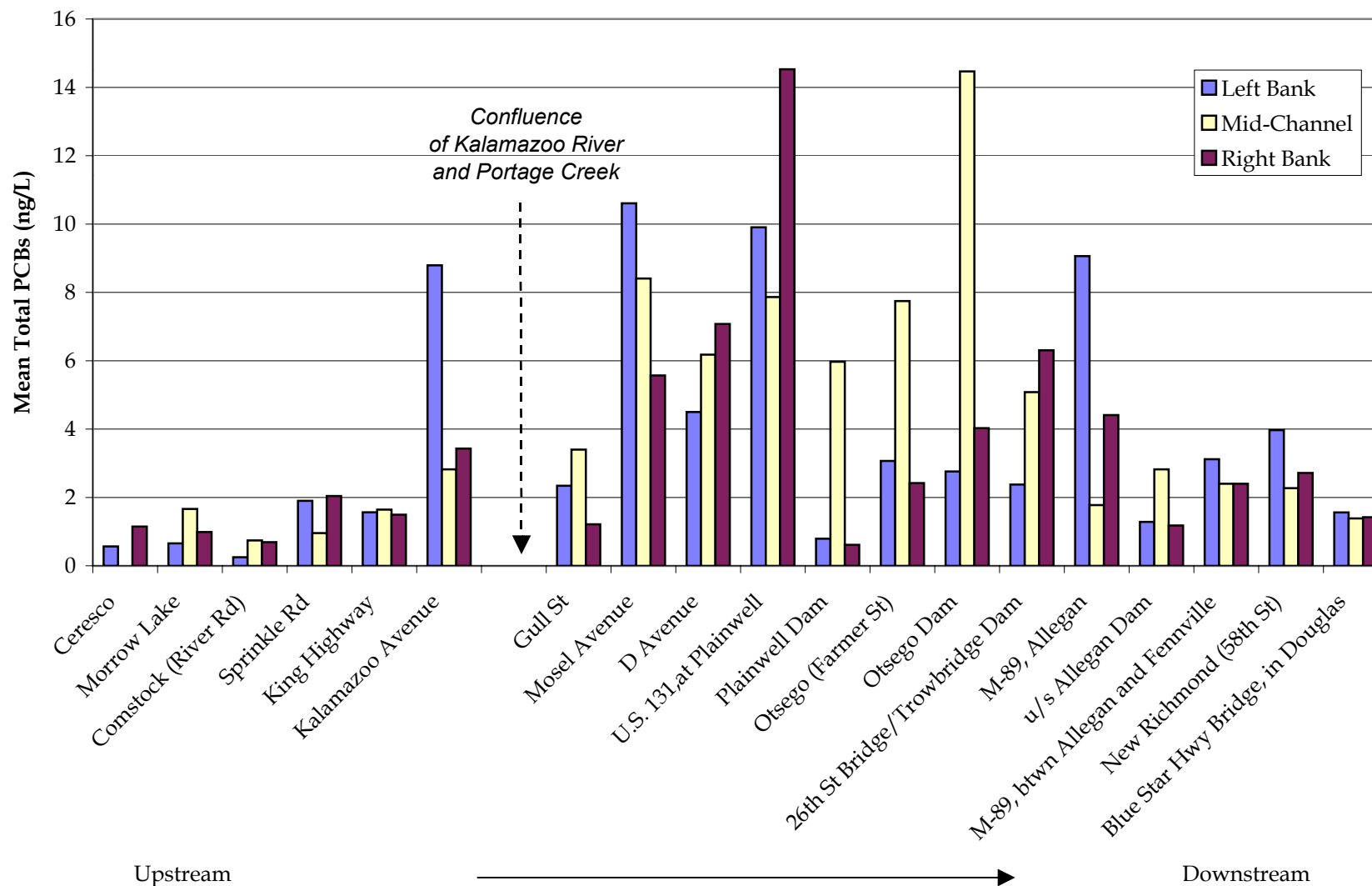


Figure 3.5. Total PCBs (Congeners) in Dry Weather Surface Water Samples, Portage Creek, Event 2 (October 17 to 22, 2000) (no bars = non-detect PCBs)

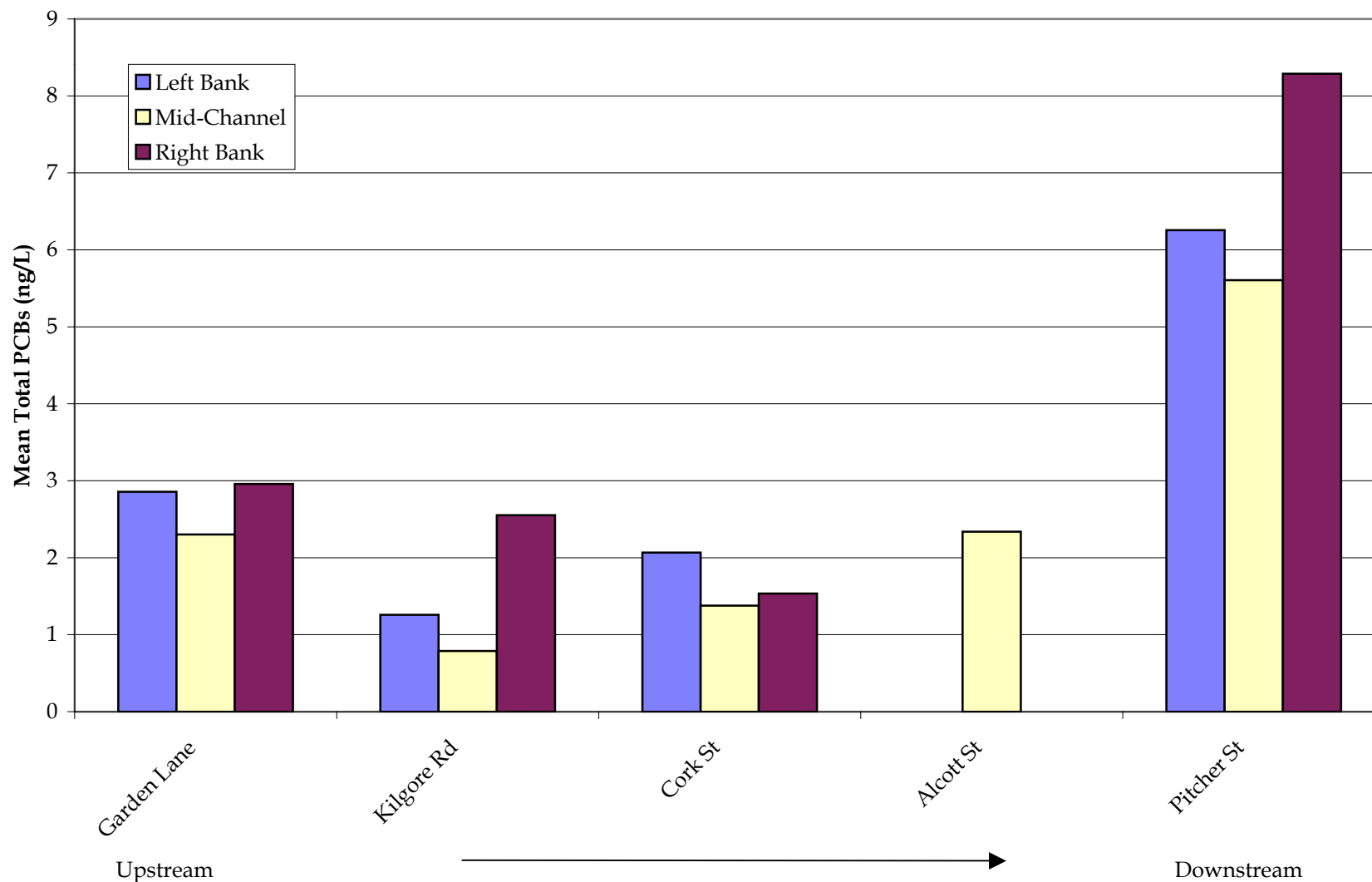
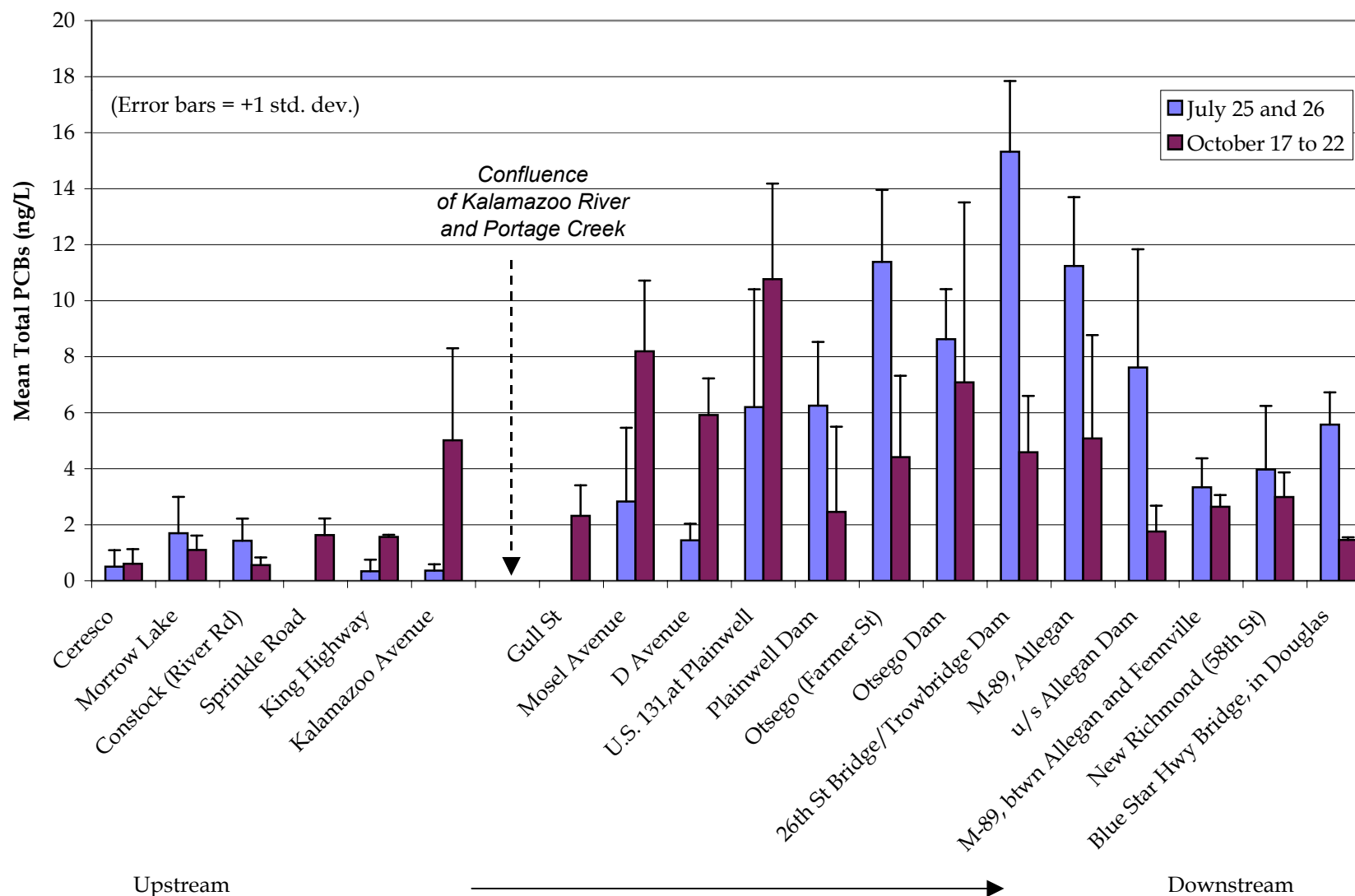


Figure 3.6. Mean Total PCBs (Congeners) in Surface Water, 2000 Dry Weather Events, Kalamazoo River
(no data = site not sampled during that event)



**Figure 3.7. Mean Total PCBs (Congeners) in Surface Water, 2000 Dry Weather Events, Portage Creek
(no data = site not sampled during that event)**

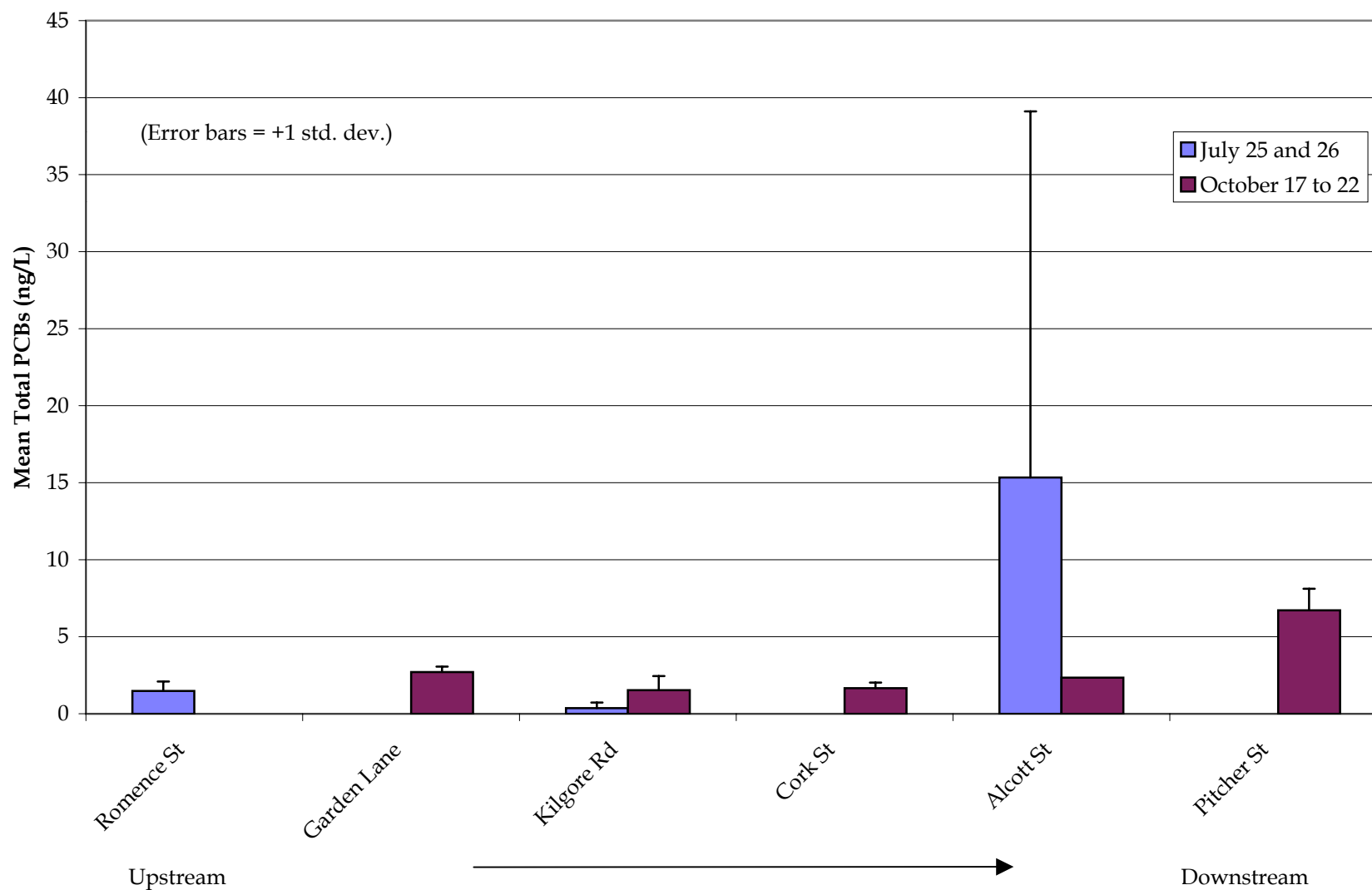


Figure 3.8. Mean Total Suspended Solids from 2000 Dry Weather Survey Sampling, Kalamazoo River
(no data = site not sampled during that event)

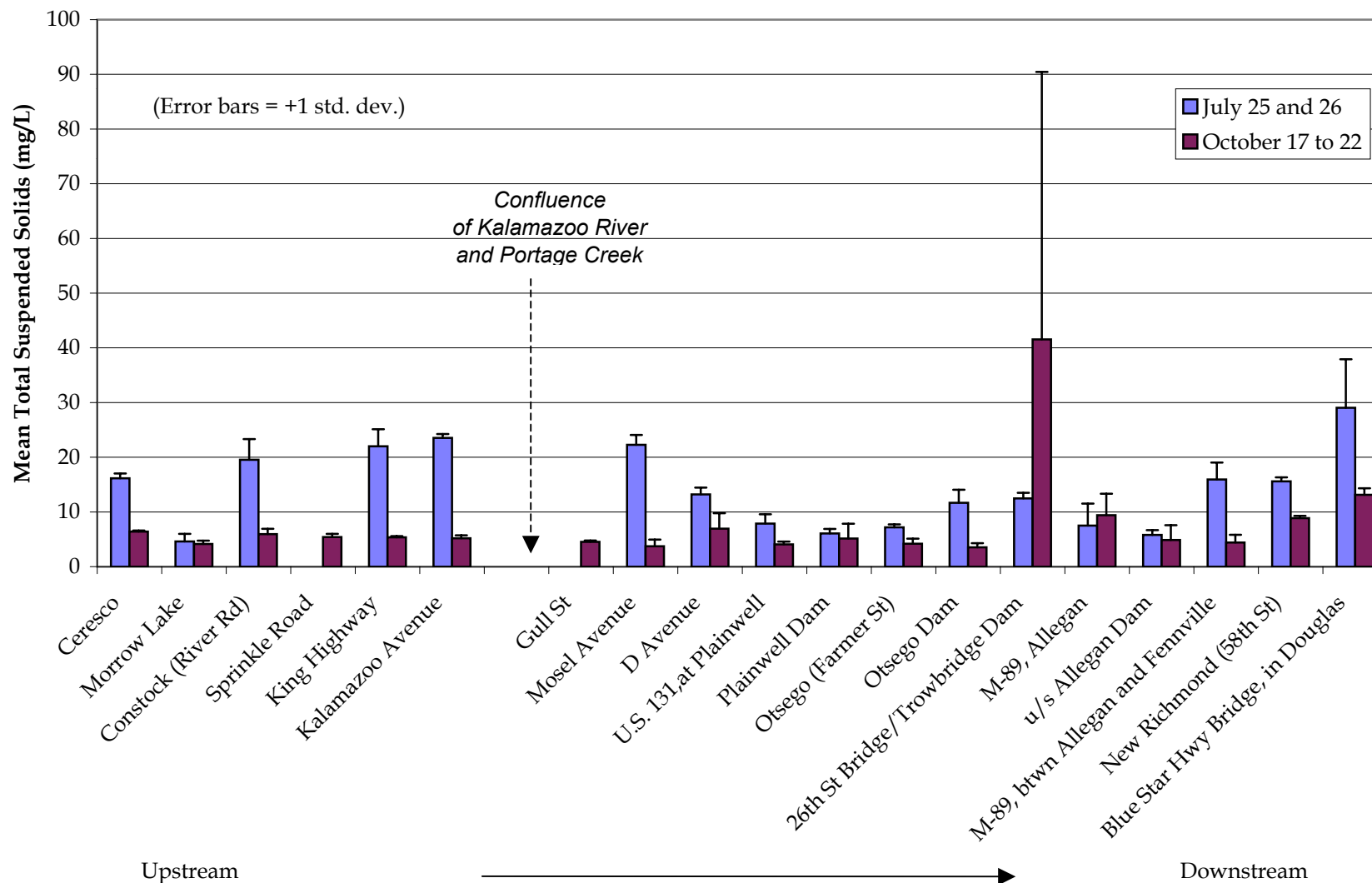


Figure 3.9. Mean Total Suspended Solids from 2000 Dry Weather Survey Sampling, Portage Creek
(no data = site not sampled during that event)

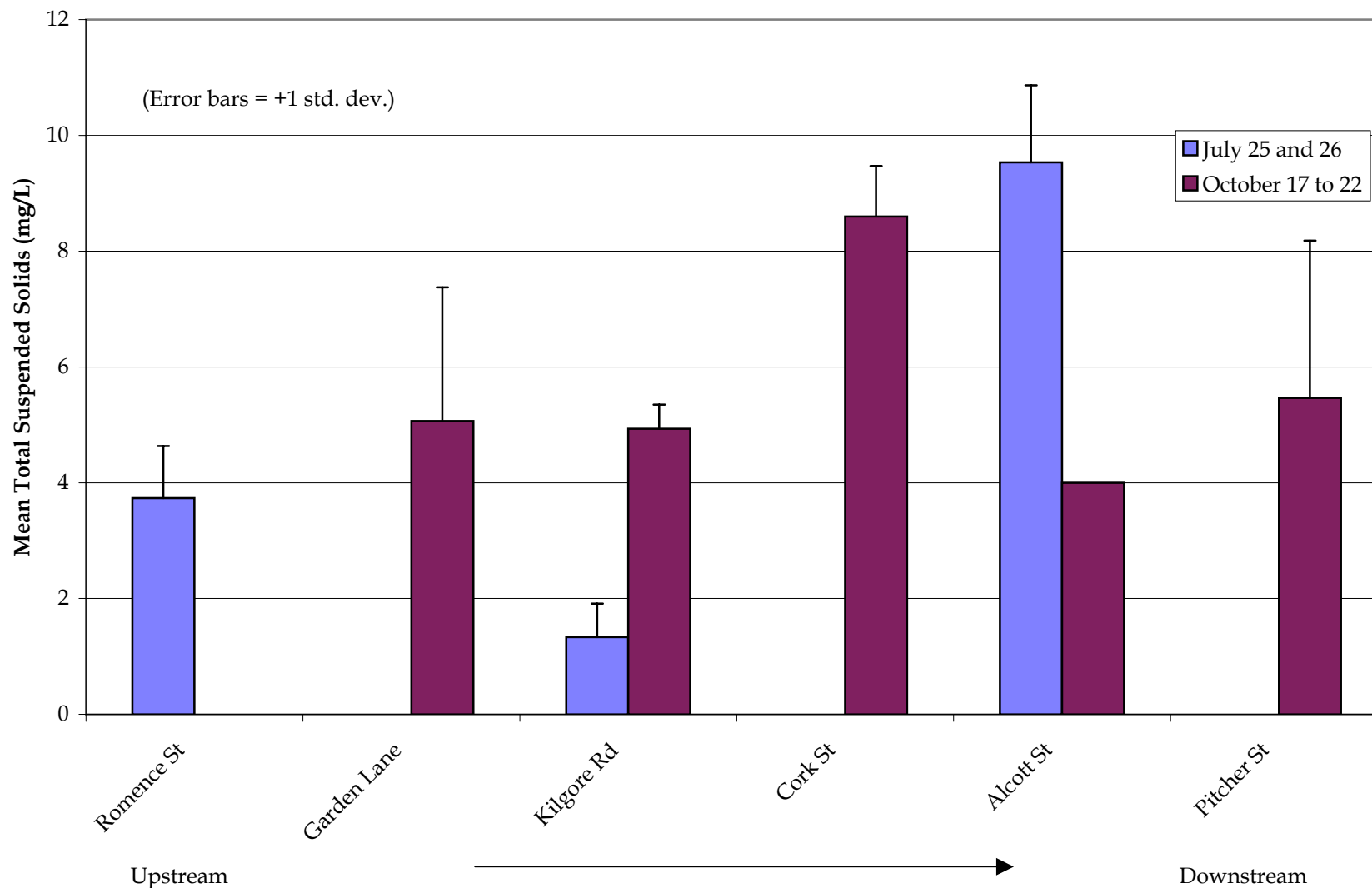


Table 3.1
Total PCB Concentrations (Congeners) in the 2000
Dry Weather Surface Water Samples Event 1 (July 25-26)

SampleID ¹ (ordered from Left to Right bank)	Location	Total PCBs (ng/L)			Mean Total PCBs (ng/L) ²	Standard Deviation (ng/L) ²	Relative Standard Deviation (%)
		Left Bank	Mid- Channel	Right Bank			
Kalamazoo River							
DW-011-1-01 to DW-011-3-01	Bridge d/s of dam at Ceresco Reservoir	1.18	0.24	< 0.20	0.51	0.59	116
DW-012-1-01 to DW-012-3-01	35th Street Bridge,at Morrow Lake	0.32	2.90	1.87	1.69	1.30	77
DW-013-1-01 to DW-013-3-01	River Road Bridge, near Comstock	2.34	0.88	1.07	1.43	0.79	56
DW-016-1-01 to DW-016-3-01	State Rt. 96, King Highway Bridge	0.81	< 0.20	< 0.20	0.34	0.41	122
DW-015-1-01 to DW-015-3-01	Kalamazoo Avenue	0.50	< 0.20	0.48	0.36	0.23	63
DW-017-1-01 to DW-017-3-01	D Avenue Bridge	0.88	1.13	2.00	1.44	0.59	41
DW-053-1-01 to DW-053-3-01	Mosel Avenue	5.68	2.33	0.49	2.83	2.63	93
DW-018-1-01 to DW-018-3-01	US 131 Highway, near Plainwell	1.95	6.28	10.37	6.20	4.21	68
DW-019-1-01 to DW-019-3-01	~ 100 feet d/s of Plainwell Dam	6.29	7.92	10.79	6.25	2.28	36
DW-020-1-01 to DW-020-3-01	Farmer St. Bridge, in Otsego	11.13	14.07	8.94	11.38	2.57	23
DW-021-1-01 to DW-021-3-01	~ 200 feet d/s of Otsego Dam	9.47	6.57	9.83	8.62	1.79	21
DW-022-1-01 to DW-022-3-01	26th St. Bridge/Trowbridge Dam	14.88	18.03	13.04	15.32	2.53	16
DW-023-1-01 to DW-023-3-01	M-89 Bridge, in Allegan	14.03	9.41	10.27	11.24	2.46	22
DW-024-1-01 to DW-024-3-01	~ 250 feet u/s of Allegan Dam	5.09	12.49	5.26	7.61	4.22	55
DW-025-1-01 to DW-025-3-01	M-89 Bridge, between Allegan and Fennville	2.21	6.54	6.18	4.97	2.40	48
DW-026-1-01 to DW-026-3-01	58th St. Bridge, d/s of New Richmond	2.15	4.02	3.85	3.34	1.03	31
DW-028-1-01 to DW-028-3-01	Blue Star Highway Bridge, in Douglas	5.64	4.40	6.70	5.58	1.15	21
Mean RSD for Event 1							53
Portage Creek							
DW-060-1-01 to DW-060-3-01	Romence Street	1.03	2.17	1.22	1.47	0.61	42
DW-014-1-01 to DW-014-3-01	Kilgore Road Bridge	0.77	< 0.20	0.20	0.36	0.36	101
DW-003-1-01 to DW-003-3-01	Alcott Street., pipe under bridge, or bridge itself	0.94	42.77	2.29	15.33	23.77	155
Mean RSD for Event 1							99

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (DW-Dry Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

2. Value used for non-detects in statistical analyses was one-half of the detection limit.

Table 3.2
Total PCB Concentrations (Congeners) in 2000
Dry Weather Surface Water Samples Event 2
(October 17-22)

SampleID1 (ordered from Left to Right bank)	Location	Total PCBs (ng/L)			Mean Total PCBs (ng/L) ²	Standard Deviation (ng/L) ²	Relative Standard Deviation (%)
		Left Bank	Mid-Channel	Right Bank			
Kalamazoo River							
DW-011-1-01 to DW-011-3-01	Bridge d/s of dam at Ceresco Reservoir	0.57	< 0.20	1.15	0.60	0.52	87
DW-012-1-01 to DW-012-3-01	35th Street Bridge, at Morrow Lake	0.66	1.66	0.99	1.10	0.51	46
DW-013-1-01 to DW-013-3-01	River Road Bridge, near Comstock	0.25	0.74	0.69	0.56	0.27	48
DW-051-1-01 to DW-051-3-01	Sprinkle Rd.	1.90	0.95	2.04	1.63	0.59	36
DW-016-1-01 to DW-016-3-01	State Rt. 96, King Highway Bridge	1.56	1.64	1.50	1.57	0.07	5
DW-015-1-01 to DW-015-3-01	Kalamazoo Avenue	8.79	2.82	3.43	5.01	3.29	66
DW-052-1-01 to DW-052-3-01	Gull St.	2.34	3.40	1.21	2.32	1.09	47
DW-053-1-01 to DW-053-3-01	Mosel Avenue	10.61	8.41	5.57	8.19	2.53	31
DW-017-1-01 to DW-017-3-01	D Avenue Bridge	4.50	6.18	7.07	5.92	1.31	22
DW-018-1-01 to DW-018-3-01	US 131 Highway, near Plainwell	9.91	7.86	14.53	10.77	3.42	32
DW-019-1-01 to DW-019-3-01	~ 100 feet d/s of Plainwell Dam	0.79	5.97	0.61	2.46	3.04	124
DW-020-1-01 to DW-020-3-01	Farmer St. Bridge, in Otsego	3.07	7.75	2.42	4.41	2.91	66
DW-021-1-01 to DW-021-3-01	~ 200 feet d/s of Otsego Dam	2.76	14.47	4.03	7.08	6.43	91
DW-022-1-01 to DW-022-3-01	26th St. Bridge/Trowbridge Dam	2.38	5.08	6.31	4.59	2.01	44
DW-023-2-01 to DW-023-3-01	M-89 Bridge, in Allegan	9.06	1.78	4.41	5.08	3.69	73
DW-024-1-01 to DW-024-3-01	~ 250 feet u/s of Allegan Dam	1.28	2.82	1.18	1.76	0.92	52
DW-025-1-01 to DW-025-3-01	M-89 Bridge, between Allegan and Fennville	3.12	2.40	2.40	2.64	0.42	16
DW-026-2-01 to DW-026-3-01	58th St. Bridge, d/s of New Richmond	3.97	2.27	2.71	2.99	0.88	29
DW-028-1-01 to DW-028-3-01	Blue Star Highway Bridge, in Douglas	1.56	1.38	1.42	1.46	0.09	6
Mean RSD for Event 2							48
Portage Creek							
DW-056-1-01 to DW-056-3-01	Garden Lane	2.86	2.30	2.96	2.71	0.35	13
DW-014-1-01 to DW-014-3-01	Kilgore Road Bridge	1.26	0.79	2.55	1.53	0.91	60
DW-055-1-01 to DW-055-3-01	Cork St.	2.07	1.38	1.53	1.66	0.36	22
DW-003-2-01	Alcott Street., pipe under bridge, or bridge itself	No Sample	2.34	No Sample	2.34	--	--
DW-054-1-01 to DW-054-3-01	Pitcher St.	6.26	5.61	8.29	6.72	1.40	21
Mean RSD for Event 2							29

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type

downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

2. Value used for non-detects in statistical analyses was one-half of the detection limit.

Table 3.3
Daily Mean Discharges during the 2000
Dry Weather Surface Water Sampling Surveys

Survey No.	Kalamazoo River near Battle Creek (USGS Gage 04105500)	Portage Creek near Kalamazoo (USGS Gage 04106300)
1	7/25/00 = 417 cfs 7/26/00 = 389 cfs	7/25/00 = 24 cfs 7/26/00 = 22 cfs
2	10/17/00 = 494 cfs 10/18/00 = 482 cfs 10/19/00 = 477 cfs 10/20/00 = 469 cfs 10/21/00 = 463 cfs 10/22/00 = 453 cfs	10/17/00 = 34 cfs 10/18/00 = 31 cfs 10/19/00 = 26 cfs 10/20/00 = 25 cfs 10/21/00 = 26 cfs 10/21/00 = 27 cfs

Table 3.4
TSS Concentrations in the 2000 Dry Weather
Surface Water Samples Event 1 (July 25-26)

SampleID1 (ordered from Left to Right bank)	Location	TSS (mg/L)			Mean TSS (mg/L) ¹	Standard Deviation (mg/L) ¹	Relative Standard Deviation (%)
		Left Bank	Mid- Channel	Right Bank			
Kalamazoo River							
DW-011-1-01 to DW-011-3-01	Bridge d/s of dam at Ceresco Reservoir	17.10	16.00	15.40	16.17	0.86	5
DW-012-1-01 to DW-012-3-01	35th Street Bridge,at Morrow Lake	3.20	6.00	4.60	4.60	1.40	30
DW-013-1-01 to DW-013-3-01	River Road Bridge, near Comstock	15.40	22.80	20.40	19.53	3.78	19
DW-016-1-01 to DW-016-3-01	Kalamazoo Avenue	22.80	24.20	23.60	23.53	0.70	3
DW-015-1-01 to DW-015-3-01	State Rt. 96, King Highway Bridge	23.60	18.40	24.00	22.00	3.12	14
DW-017-1-01 to DW-017-3-01	D Avenue Bridge	11.80	14.20	13.60	13.20	1.25	9
DW-053-1-01 to DW-053-3-01	US 131 Highway, near Plainwell	7.80	6.20	9.60	7.87	1.70	22
DW-018-1-01 to DW-018-3-01	~ 100 feet d/s of Plainwell Dam	7.00	5.40	5.80	6.07	0.83	14
DW-019-1-01 to DW-019-3-01	Farmer St. Bridge, in Otsego	6.80	7.80	6.99	7.20	0.53	7
DW-020-1-01 to DW-020-3-01	~ 200 feet d/s of Otsego Dam	14.00	11.80	9.20	11.67	2.40	21
DW-021-1-01 to DW-021-3-01	26th St. Bridge/Trowbridge Dam	12.20	11.60	13.60	12.47	1.03	8
DW-022-1-01 to DW-022-3-01	M-89 Bridge, in Allegan	4.60	5.80	12.10	7.50	4.03	54
DW-023-1-01 to DW-023-3-01	~ 250 feet u/s of Allegan Dam	5.40	5.20	6.80	5.80	0.87	15
DW-024-1-01 to DW-024-3-01	M-89 Bridge, between Allegan and Fennville	16.20	15.80	14.80	15.60	0.72	5
DW-025-1-01 to DW-025-3-01	58th St. Bridge, d/s of New Richmond	16.80	18.50	12.50	15.93	3.09	19
DW-026-1-01 to DW-026-3-01	Blue Star Highway Bridge, in Douglas	34.80	18.80	33.50	29.03	8.89	31
DW-028-1-01 to DW-028-3-01	Mosel Avenue	22.00	24.20	20.60	22.27	1.81	8
Mean RSD for Event 1							17
Portage Creek							
DW-060-1-01 to DW-060-3-01	Romence Street	2.80	4.60	3.80	3.73	0.90	24
DW-014-1-01 to DW-014-3-01	Kilgore Road Bridge	< 2.00	< 2.00	2.00	1.33	0.58	43
DW-003-1-01 to DW-003-3-01	Alcott Street., pipe under bridge, or bridge itself	9.20	11.00	8.40	9.53	1.33	14
Mean RSD for Event 1							27

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (DW-Dry Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

1. Value used for non-detects in statistical analyses was one-half of the detection limit.

TSS Concentration
Table 3.5
Water Samples Event 2 (October 17-22)

SampleID1 (ordered from Left to Right bank)	Location	TSS (mg/L)			Mean TSS (mg/L) ¹	Standard Deviation (mg/L) ¹	Relative Standard Deviation (%)
		Left Bank	Mid-Channel	Right Bank			
Kalamazoo River							
DW-011-1-01 to DW-011-3-01	Bridge d/s of dam at Ceresco Reservoir	6.20	6.60	6.40	6.40	0.20	3
DW-012-1-01 to DW-012-3-01	35th Street Bridge,at Morrow Lake	4.80	4.00	3.60	4.13	0.61	15
DW-013-1-01 to DW-013-3-01	River Road Bridge, near Comstock	6.40	6.60	4.80	5.93	0.99	17
DW-051-1-01 to DW-051-3-01	Sprinkle Rd.	5.40	4.80	6.00	5.40	0.60	11
DW-016-1-01 to DW-016-3-01	State Rt. 96, King Highway Bridge	5.31	5.20	5.60	5.37	0.21	4
DW-015-1-01 to DW-015-3-01	Kalamazoo Avenue	5.60	5.40	4.60	5.20	0.53	10
DW-052-1-01 to DW-052-3-01	Gull St.	4.40	4.80	4.40	4.53	0.23	5
DW-053-1-01 to DW-053-3-01	Mosel Avenue	5.00	3.60	2.60	3.73	1.21	32
DW-017-1-01 to DW-017-3-01	D Avenue Bridge	4.40	6.40	10.00	6.93	2.84	41
DW-018-1-01 to DW-018-3-01	US 131 Highway, near Plainwell	4.60	4.00	3.60	4.07	0.50	12
DW-019-1-01 to DW-019-2-01	~ 100 feet d/s of Plainwell Dam	6.60	6.80	2.00	5.13	2.72	53
DW-020-1-01 to DW-020-3-01	Farmer St. Bridge, in Otsego	5.20	3.40	4.00	4.20	0.92	22
DW-021-1-01 to DW-021-3-01	~ 200 feet d/s of Otsego Dam	3.20	3.00	4.40	3.53	0.76	21
DW-022-1-01 to DW-022-3-01	26th St. Bridge/Trowbridge Dam	7.60	19.40	97.60	41.53	48.91	118
DW-023-1-01 to DW-023-3-01	M-89 Bridge, in Allegan	8.20	6.20	13.80	9.40	3.94	42
DW-024-1-01 to DW-024-3-01	~ 250 feet u/s of Allegan Dam	3.20	8.00	3.40	4.87	2.72	56
DW-026-1-01 to DW-026-2-01	58th St. Bridge, d/s of New Richmond	3.40	5.40	No Sample	4.40	1.41	32
DW-028-1-01 to DW-028-3-01	Blue Star Highway Bridge, in Douglas	14.40	12.00	13.00	13.13	1.21	9
Mean RSD for Event 2							28
Portage Creek							
DW-056-1-01 to DW-056-3-01	Garden Lane	2.40	6.40	6.40	5.07	2.31	46
DW-014-1-01 to DW-014-3-01	Kilgore Road Bridge	4.80	5.40	4.60	4.93	0.42	8
DW-055-1-01 to DW-055-3-01	Cork St.	8.20	9.60	8.00	8.60	0.87	10
DW-003-2-01	Alcott Street., pipe under bridge, or bridge itself	4.00	No Sample	No Sample	4.00	--	--
DW-054-1-01 to DW-054-3-01	Pitcher St.	3.80	8.60	4.00	5.47	2.72	50
Mean RSD for Event 2							28

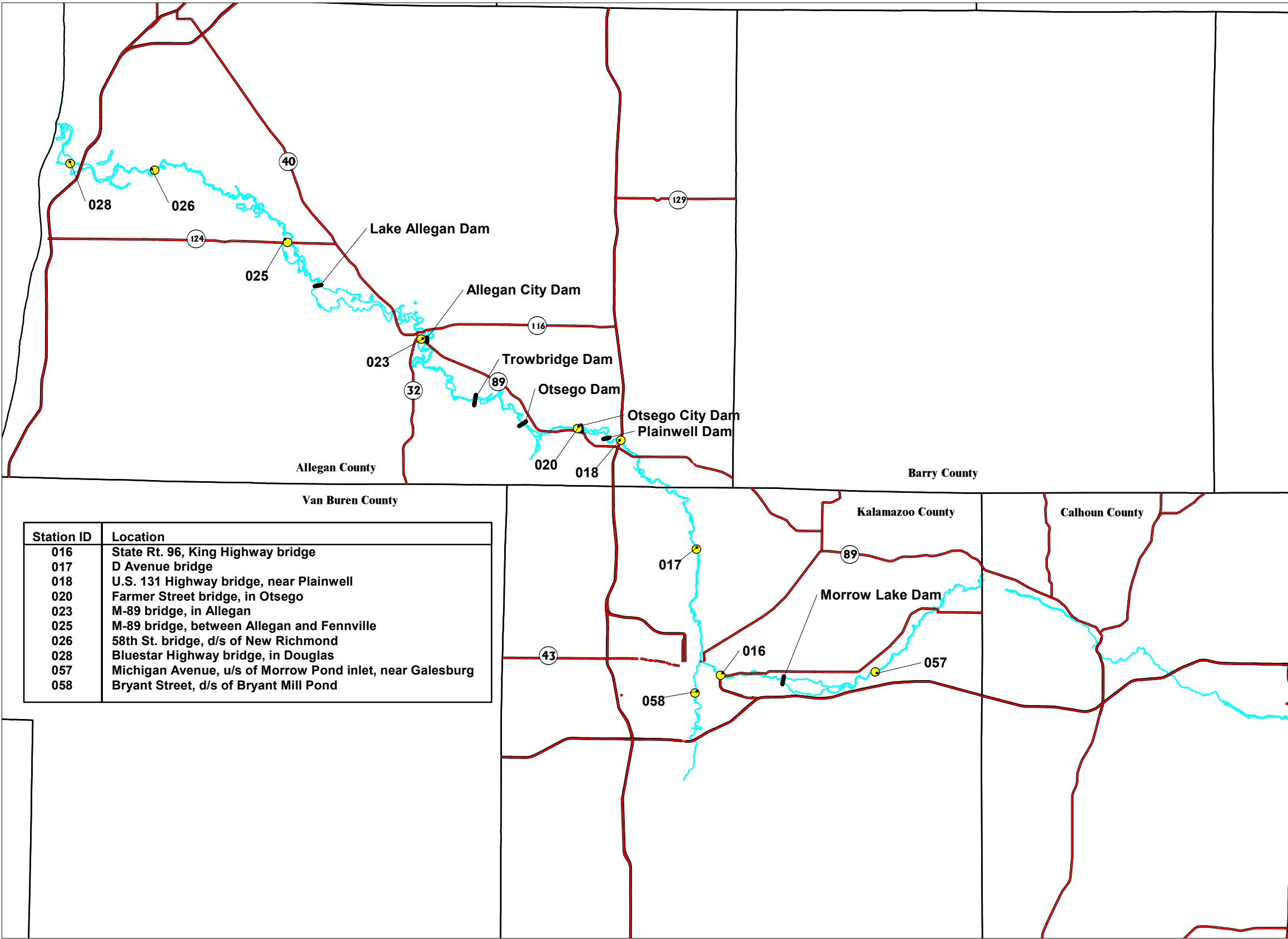
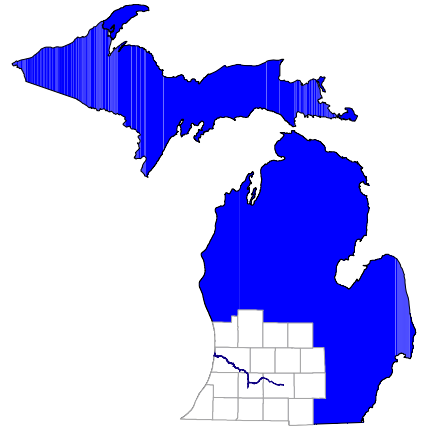
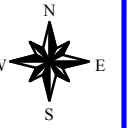
Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (DW-Dry Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

1. Value used for non-detects in statistical analyses was one-half of the detection limit.

Wet Weather

Figures
Tables



Station ID	Location
016	State Rt. 96, King Highway bridge
017	D Avenue bridge
018	U.S. 131 Highway bridge, near Plainwell
020	Farmer Street bridge, in Otsego
023	M-89 bridge, in Allegan
025	M-89 bridge, between Allegan and Fennville
026	58th St. bridge, d/s of New Richmond
028	Bluestar Highway bridge, in Douglas
057	Michigan Avenue, u/s of Morrow Pond inlet, near Galesburg
058	Bryant Street, d/s of Bryant Mill Pond

LEGEND

- Wet Weather Stations
- Dams
- Highways
- County Boundaries
- Portage Creek / Kalamazoo River



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Prepared By:
A. Santini
Updated:
1/16/02

Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site

Long Term Monitoring - 2000
Wet Weather Sampling Locations

Figure No.
3-10

Figure 3.11. Mean Total PCB Concentrations (Congeners) in Wet Weather Water Samples, Rising Limb (April 21) and Falling Limb (April 26) 2000

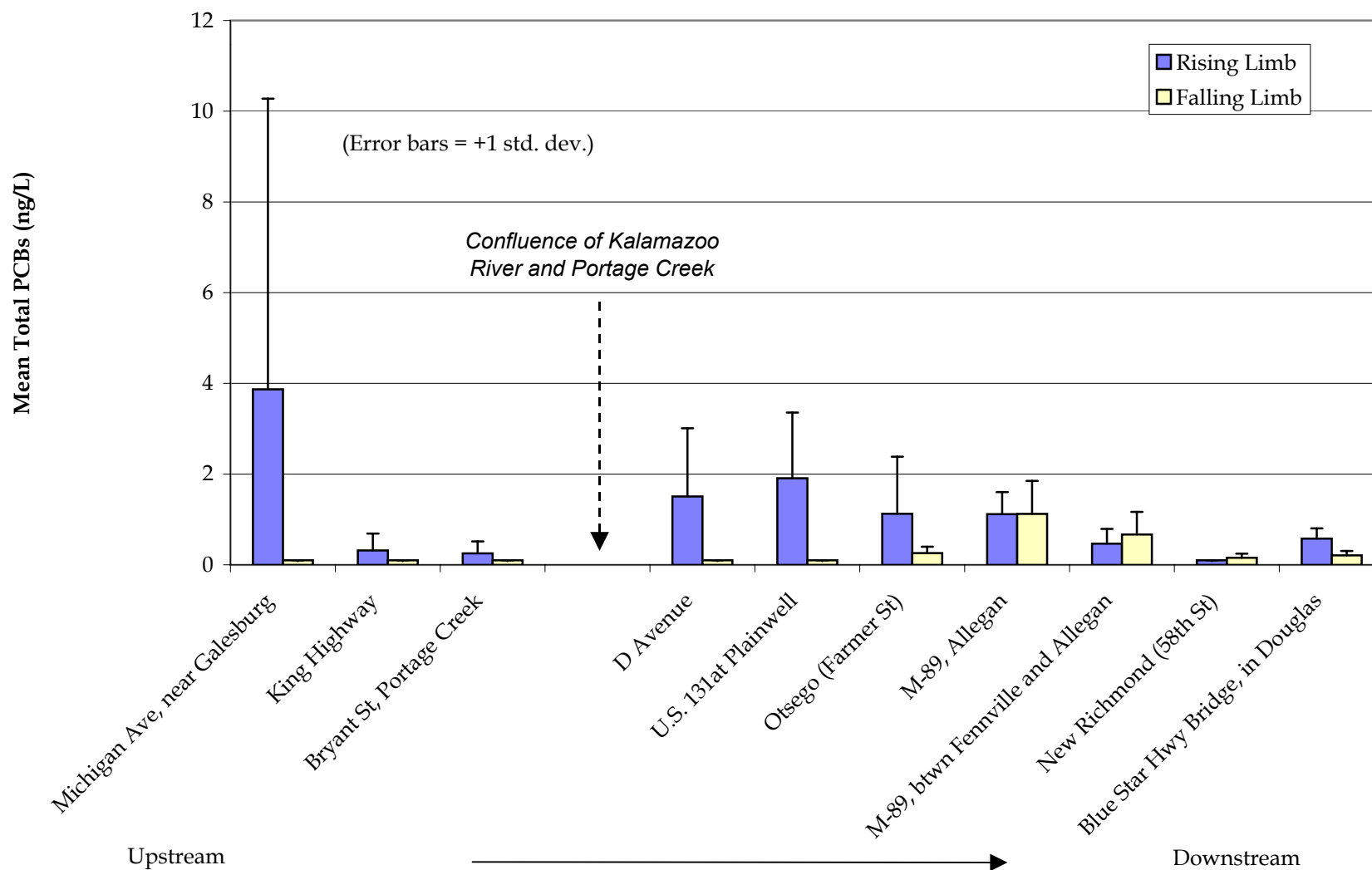
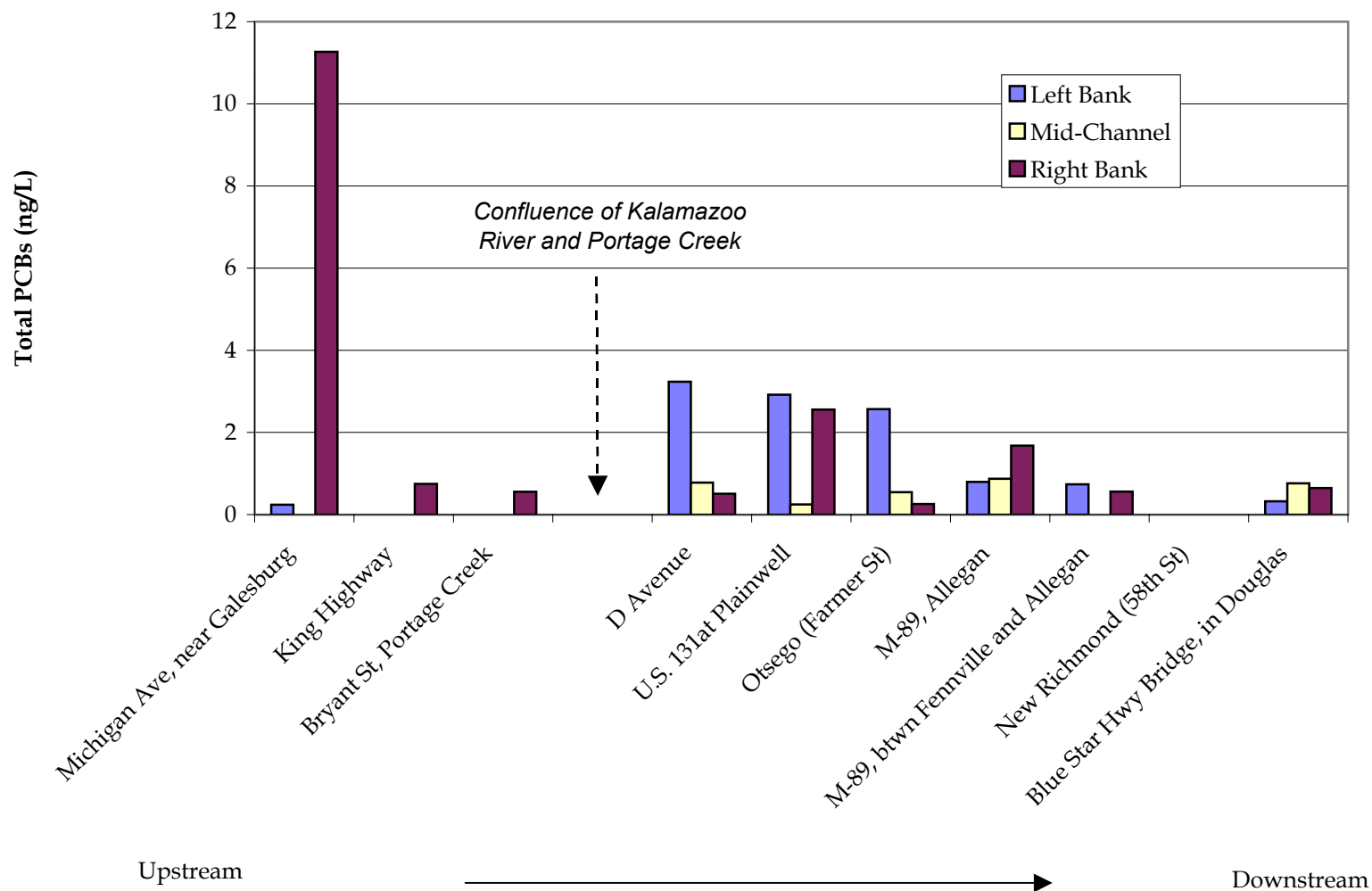


Figure 3.12. Total PCBs (Congeners) in Wet Weather Surface Water Samples,
Rising Limb (April 21, 2000)
(no bars=non-detect)



**Figure 3.13. Total PCBs (Congeners) in Wet Weather Surface Water Samples,
Falling Limb (April 26, 2000)
(no bars=non-detect)**

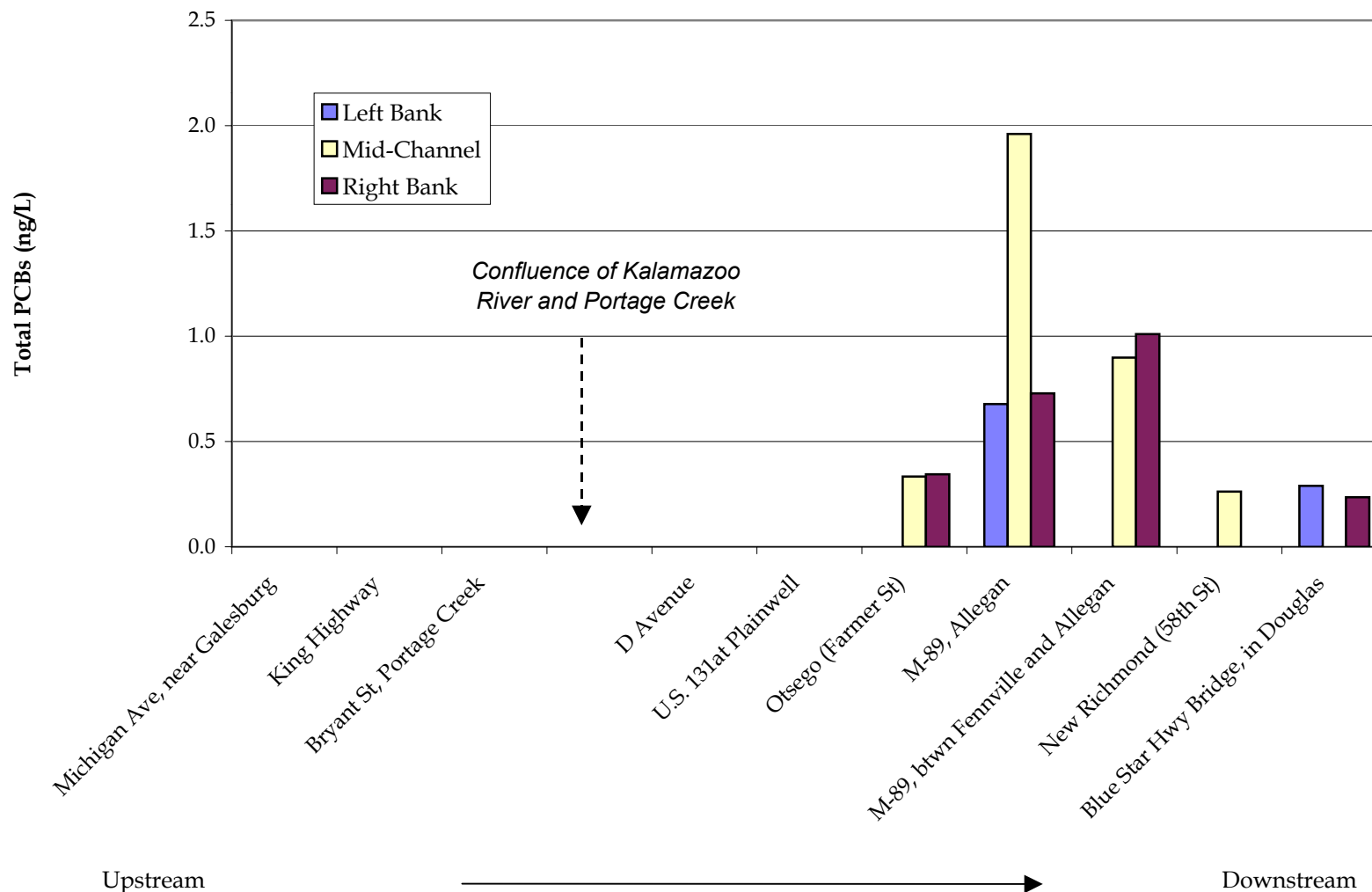


Figure 3.14. Mean Total Suspended Solids Concentrations in the Wet Weather Water Samples, Rising Limb (April 21) and Falling Limb (April 26) 2000

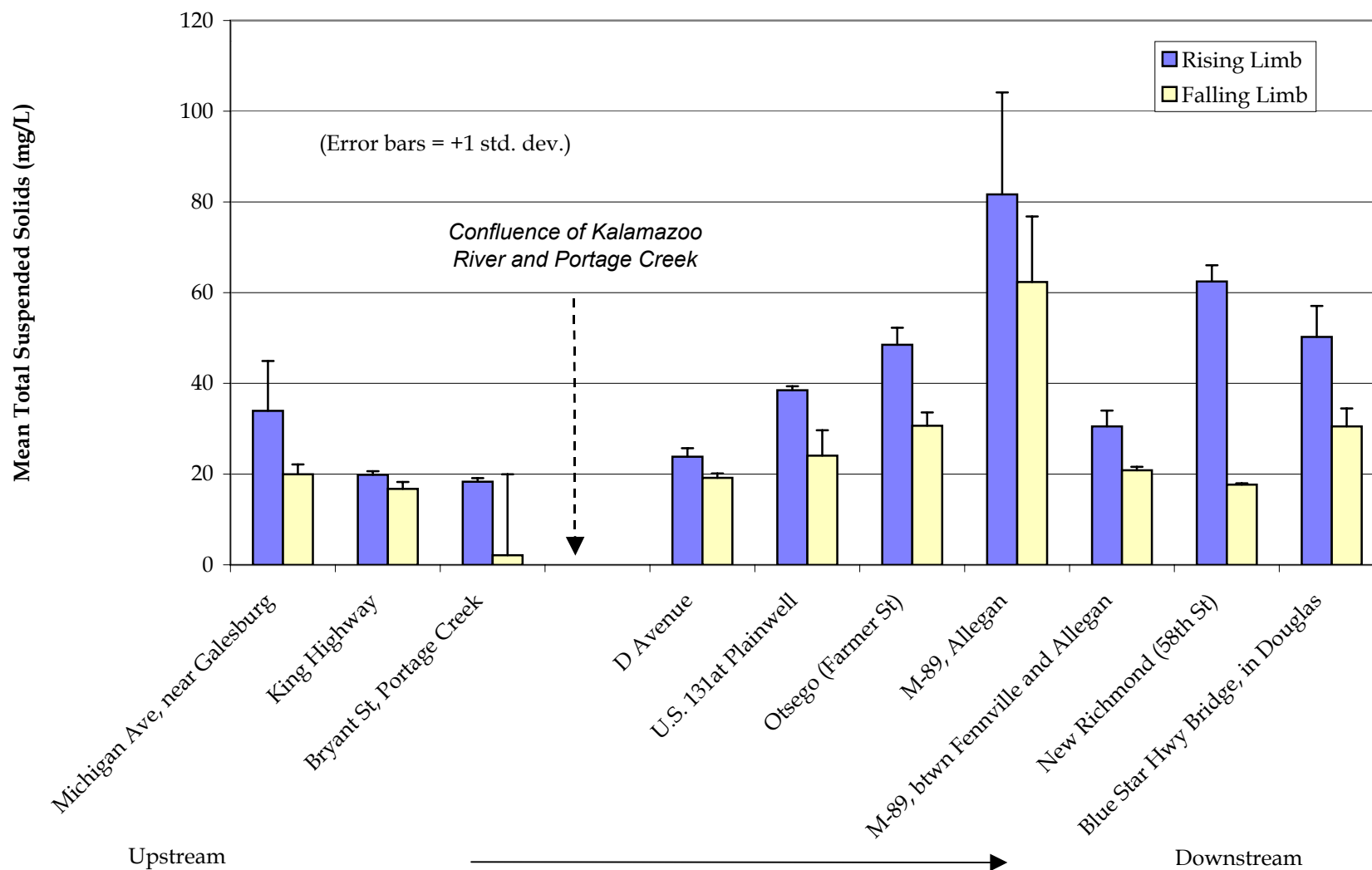


Table 3.6
Total PCB Concentrations (Congeners) in the 2000
"Rising Limb" Wet Weather Surface Water Samples (April 21, 2000)

SampleID ¹ (ordered from Left to Right bank)	Location	Total PCB (ng/L)			Mean Total PCBs (ng/L) ²	Standard Deviation (ng/L) ²	Relative Standard Deviation (%)
		Left Bank	Mid- Channel	Right Bank			
WW-057-1-01 to WW-057-3-01	Michigan Avenue, u/s of Morrow Lake inlet, near Galesburg	0.24	< 0.20	11.27	3.87	6.41	166
WW-016-1-01 to WW-016-3-01	State Rt. 96, King Highway Bridge	< 0.20	< 0.20	0.75	0.32	0.37	118
WW-058-1-01 to WW-058-3-01	Portage Creek--Bryant Street, d/s of Bryant Mill Pond	< 0.20	< 0.20	0.56	0.25	0.26	105
WW-017-1-01 to WW-017-3-01	D Avenue Bridge	3.24	0.78	0.51	1.51	1.50	100
WW-018-1-01 to WW-018-3-01	US 131 Highway Bridge, near Plainwell	2.92	0.25	2.56	1.91	1.45	76
WW-020-1-01 to WW-020-3-01	Farmer Street Bridge, in Otsego	2.57	0.55	0.26	1.12	1.26	112
WW-023-1-01 to WW-023-3-01	M-89 Bridge, in Allegan	0.80	0.87	1.68	1.12	0.49	44
WW-025-1-01 to WW-025-3-01	M-89 Bridge, between Allegan and Fennville	0.74	< 0.20	0.56	0.46	0.33	71
WW-026-1-01 to WW-026-3-01	58th St. Bridge, d/s of New Richmond	< 0.20	< 0.20	< 0.20	0.10	0.00	0
WW-028-1-01 to WW-028-3-01	Blue Star Highway Bridge, in Douglas	0.32	0.76	0.65	0.58	0.23	39
Mean RSD for Rising Limb							83

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit.

Table 3.7
Total PCB Concentrations (Congeners) in the 2000
"Falling Limb" Wet Weather Surface Water Samples (April 26, 2000)

SampleID' (ordered from Left to Right bank)	Location	Total PCBs (ng/L)			Mean Total PCBs (ng/L) ²	Standard Deviation (ng/L) ²	Relative Standard Deviation (%)
		Left Bank	Mid- Channel	Right Bank			
WW-057-1-01 to WW-057-3-01	Michigan Avenue, u/s of Morrow Lake inlet, near Galesburg	< 0.20	< 0.20	< 0.20	0.10	0.00	0
WW-016-2-01to WW-016-3-01	State Rt. 96, King Highway Bridge		< 0.20	< 0.20	0.10	0.00	0
WW-058-1-01 to WW-058-3-01	Portage Creek--Bryant Street, d/s of Bryant Mill Pond	< 0.20	< 0.20	< 0.20	0.10	0.00	0
WW-017-1-01 to WW-017-3-01	D Avenue Bridge	< 0.20	< 0.20	< 0.20	0.10	0.00	0
WW-018-1-01 to WW-018-3-01	US 131 Highway Bridge, near Plainwell	< 0.20	< 0.20	< 0.20	0.10	0.00	0
WW-020-1-01 to WW-020-3-01	Farmer Street Bridge, in Otsego	< 0.20	0.33	0.34	0.26	0.14	53
WW-023-1-01 to WW-023-3-01	M-89 Bridge, in Allegan	0.68	1.96	0.73	1.12	0.73	65
WW-025-1-01 to WW-025-3-01	M-89 Bridge, between Allegan and Fennville	< 0.20	0.90	1.01	0.67	0.50	74
WW-026-1-01 to WW-026-3-01	58th St. Bridge, d/s of New Richmond	< 0.20	0.26	< 0.20	0.15	0.09	61
WW-028-1-01 to WW-028-3-01	Blue Star Highway Bridge, in Douglas	0.29	< 0.20	0.24	0.21	0.10	47
Mean RSD for Falling Limb							30

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)
2. Value used for non-detects in statistical analyses was one-half of the detection limit.

Table 3.8
TSS Concentrations in the 2000 "Rising Limb"
Wet Weather Surface Water Samples (April 21, 2000)

SampleID ¹ (ordered from Left to Right)	Location	TSS (mg/L)			Mean TSS (mg/L)	Standard Deviation (mg/L)	Relative Standard Deviation
		Left Bank	Mid- Channel	Right Bank			
WW-057-1-01 to WW-057-3-01	Michigan Avenue, u/s of Morrow Lake inlet, near Galesburg	31.3	46	24.5	33.93	10.99	32
WW-016-1-01 to WW-016-3-01	State Rt. 96, King Highway Bridge	19.7	19.1	20.7	19.83	0.81	4
WW-058-1-01 to WW-058-3-01	Portage Creek--Bryant Street, d/s of Bryant Mill Pond	19	18.5	17.5	18.33	0.76	4
WW-017-1-01 to WW-017-3-01	D Avenue Bridge	24.7	21.7	25.1	23.83	1.86	8
WW-018-1-01 to WW-018-3-01	US 131 Highway Bridge, near Plainwell	39	37.5	39	38.50	0.87	2
WW-020-1-01 to WW-020-3-01	Farmer Street Bridge, in Otsego	44.5	49	52	48.50	3.77	8
WW-023-1-01 to WW-023-3-01	M-89 Bridge, in Allegan	87	101	57	81.67	22.48	28
WW-025-1-01 to WW-025-3-01	M-89 Bridge, between Allegan and Fennville	27	34	30.5	30.50	3.50	11
WW-026-1-01 to WW-026-3-01	58th St. Bridge, d/s of New Richmond	58.4	65	64	62.47	3.56	6
WW-028-1-01 to WW-028-3-01	Blue Star Highway Bridge, in Douglas	58	45.1	47.6	50.23	6.84	14
<i>Mean RSD for Rising Limb</i>							12

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

Table 3.9

Wet Weather Surface Water Samples (April 26, 2000)

SampleID1 (ordered from Left to Right bank)	Location	TSS (mg/L)			Mean TSS (mg/L)	Standard Deviation (mg/L)	Relative Standard Deviation (%)
		Left Bank	Mid- Channel	Right Bank			
WW-057-1-01 to WW-057-3-01	Michigan Avenue, u/s of Morrow Lake inlet, near Galesburg	21.6	20.8	17.5	19.97	2.17	11
WW-016-1-01to WW-016-3-01	State Rt. 96, King Highway Bridge	15.7	16	18.5	16.73	1.54	9
WW-058-1-01 to WW-058-3-01	Portage Creek--Bryant Street, d/s of Bryant Mill Pond	9.8	14	11.6	11.80	2.11	18
WW-017-1-01 to WW-017-3-01	D Avenue Bridge	18.6	18.6	20.3	19.17	0.98	5
WW-018-1-01 to WW-018-3-01	US 131 Highway Bridge, near Plainwell	30.5	20.3	21.4	24.07	5.60	23
WW-020-1-01 to WW-020-3-01	Farmer Street Bridge, in Otsego	28.5	29.5	34	30.67	2.93	10
WW-023-1-01 to WW-023-3-01	M-89 Bridge, in Allegan	46	73.5	67.5	62.33	14.46	23
WW-025-1-01 to WW-025-3-01	M-89 Bridge, between Allegan and Fennville	21.5	20	21	20.83	0.76	4
WW-026-1-01 to WW-026-3-01	58th St. Bridge, d/s of New Richmond	17.5	17.5	18	17.67	0.29	2
WW-028-1-01 to WW-028-3-01	Blue Star Highway Bridge, in Douglas	26	33.5	32	30.50	3.97	13
<i>Mean RSD for Falling Limb</i>							<i>12</i>

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (WW-Wet Weather); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

Resident Fish Collections

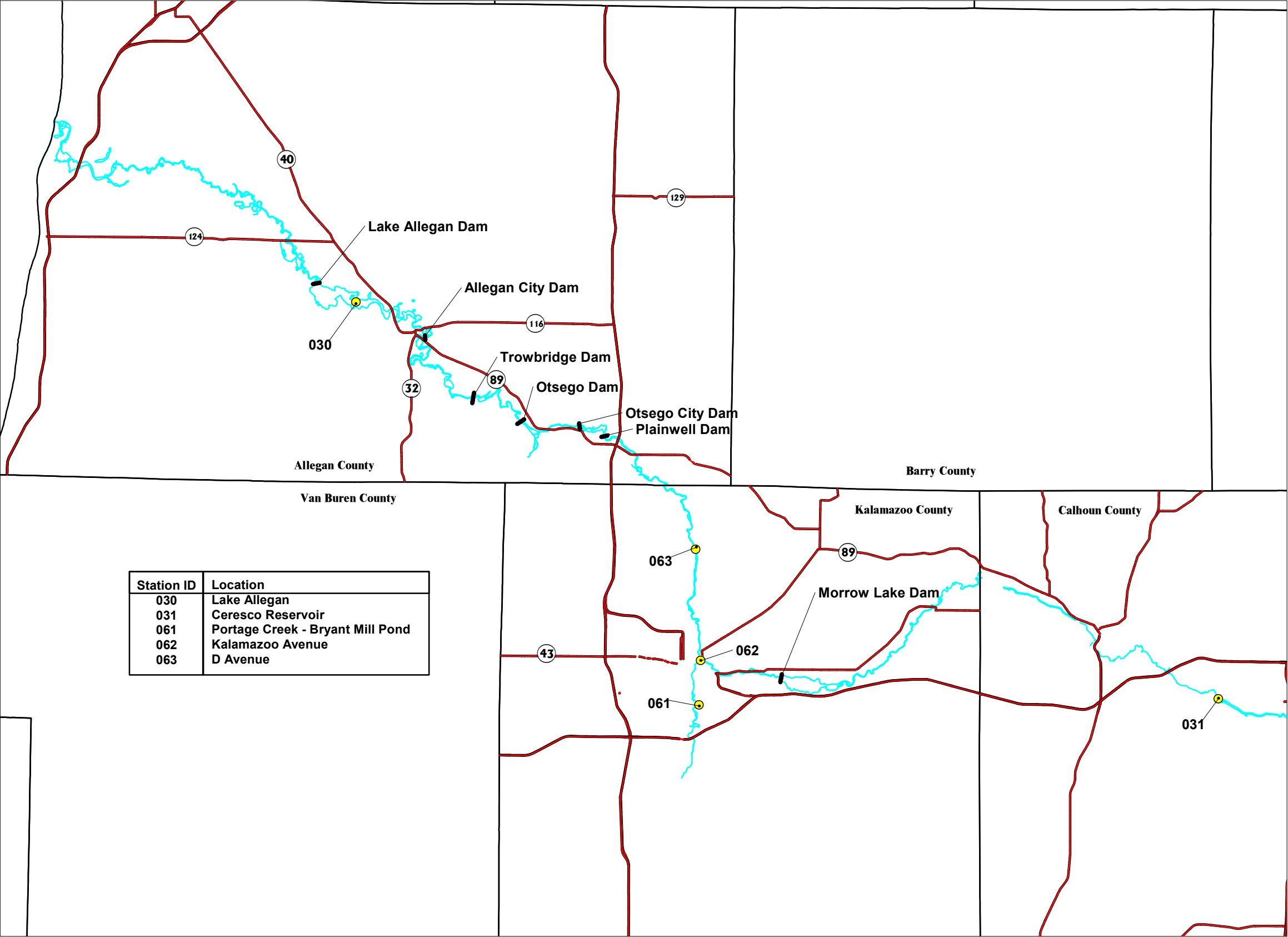
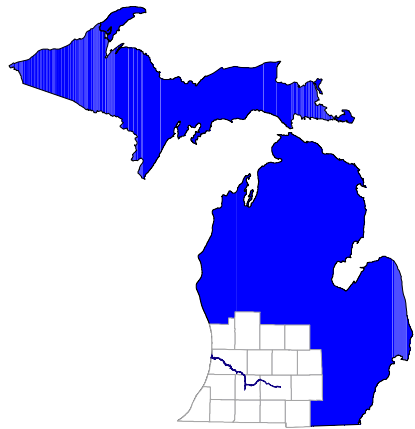
Yearling Smallmouth Bass and White Suckers

Adult Smallmouth Bass

Adult Carp

Other Fish

Bedded Sediment



Station ID	Location
030	Lake Allegan
031	Ceresco Reservoir
061	Portage Creek - Bryant Mill Pond
062	Kalamazoo Avenue
063	D Avenue

LEGEND

- Resident Fish Stations
- Dams
- Highways
- County Boundaries
- Portage Creek / Kalamazoo River

0 2 4 6 8 10 Miles

CDM

One Woodward Ave., Suite 1500
Detroit, Michigan 48226
Phone: (313) 963-1313
Fax: (313) 963-3130

Prepared By:
A. Santini
Updated:
1/16/02

**Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site**

**Long Term Monitoring - 2000
Resident Fish Locations**

**Figure No.
3-15**

Table 3.10
Fish Collected from the Kalamazoo River in 2000

General Location	Fish Species Collected	Number Collected
Ceresco Reservoir and river just downstream	Adult Smallmouth Bass	11
	Adult Carp	11
	Yearling Smallmouth Bass	25
Kalamazoo Avenue	Adult Smallmouth Bass	11
	Adult Carp	6
	Yearling Smallmouth Bass	5
	Northern Pike	1
	Rock Bass	1
Portage Creek, Bryant Mill Pond	Adult Carp	11
	Yearling White Suckers	25
	Brown Trout	1
D Avenue	Adult Smallmouth Bass	11
	Adult Carp	5
Lake Allegan	Adult Smallmouth Bass	10
	Adult Carp	11
	Yearling Smallmouth Bass	25
	Black Crappie	1
	Largemouth Bass	1
	Walleye	2

Yearling Smallmouth Bass Yearling White Suckers

Figures
Tables

Figure 3.16. Mean Total PCBs (Congeners) in 2000 Yearling Fish
(n=5, except n=1 at Kalamazoo Avenue)
(Wet-Weight Data)

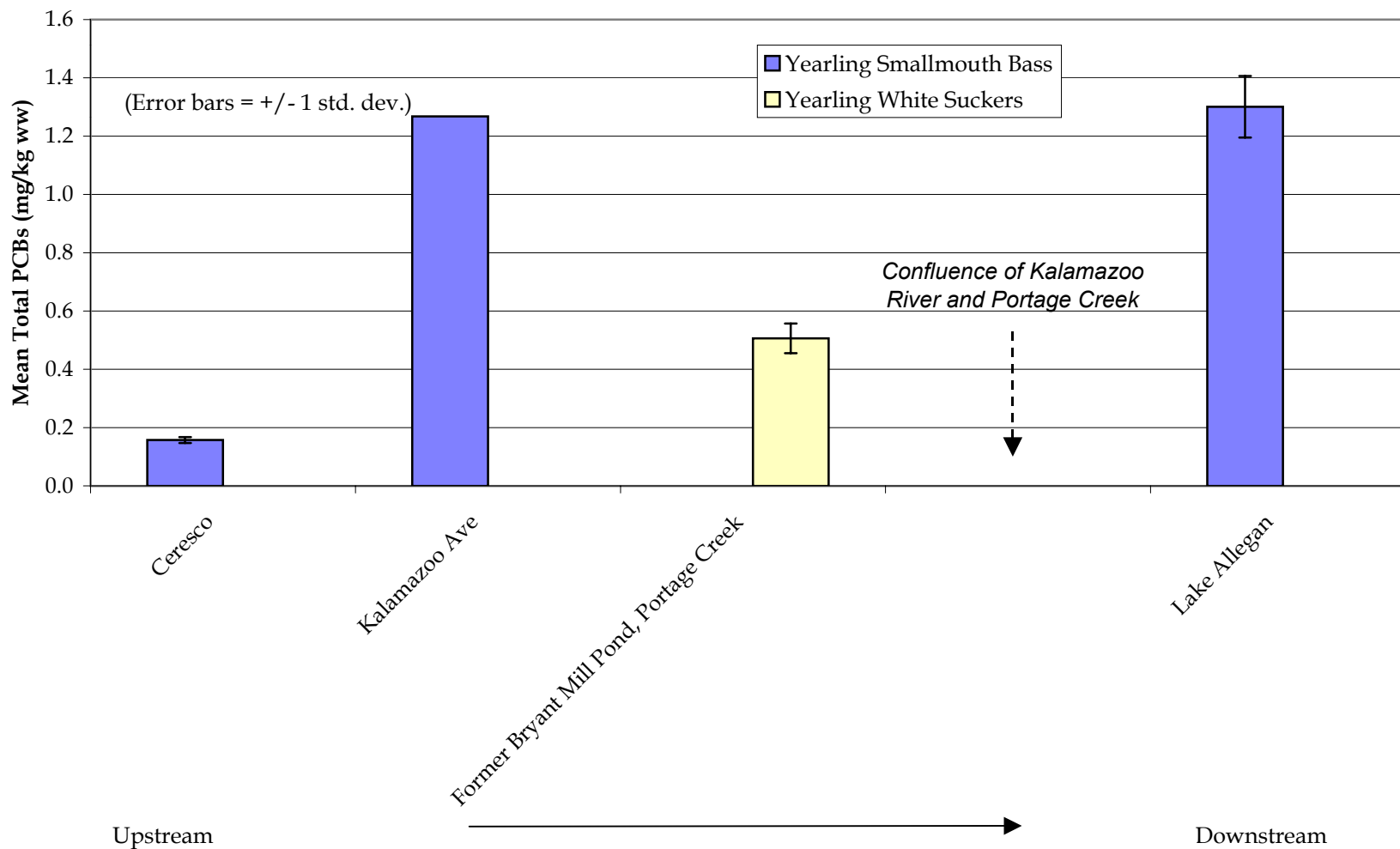


Figure 3.17. Mean Total PCBs in 2000 Yearling Fish
(n=5, except n=1 at Kalamazoo Avenue)
(Lipid-Normalized Data)

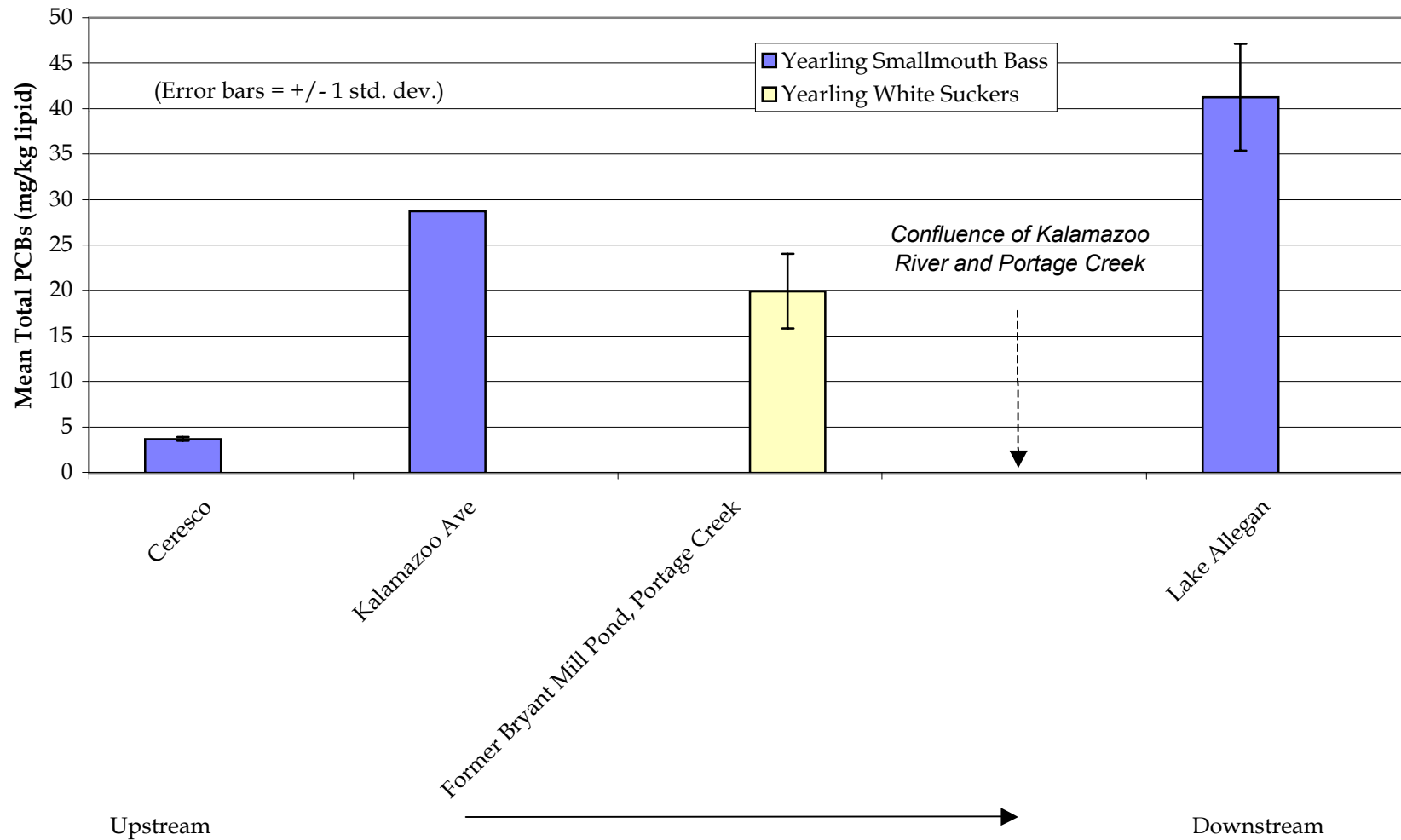


Figure 3.18. Tissue Lipid Content in 2000 Yearling Fish
(n=5, except n=1 at Kalamazoo Avenue)

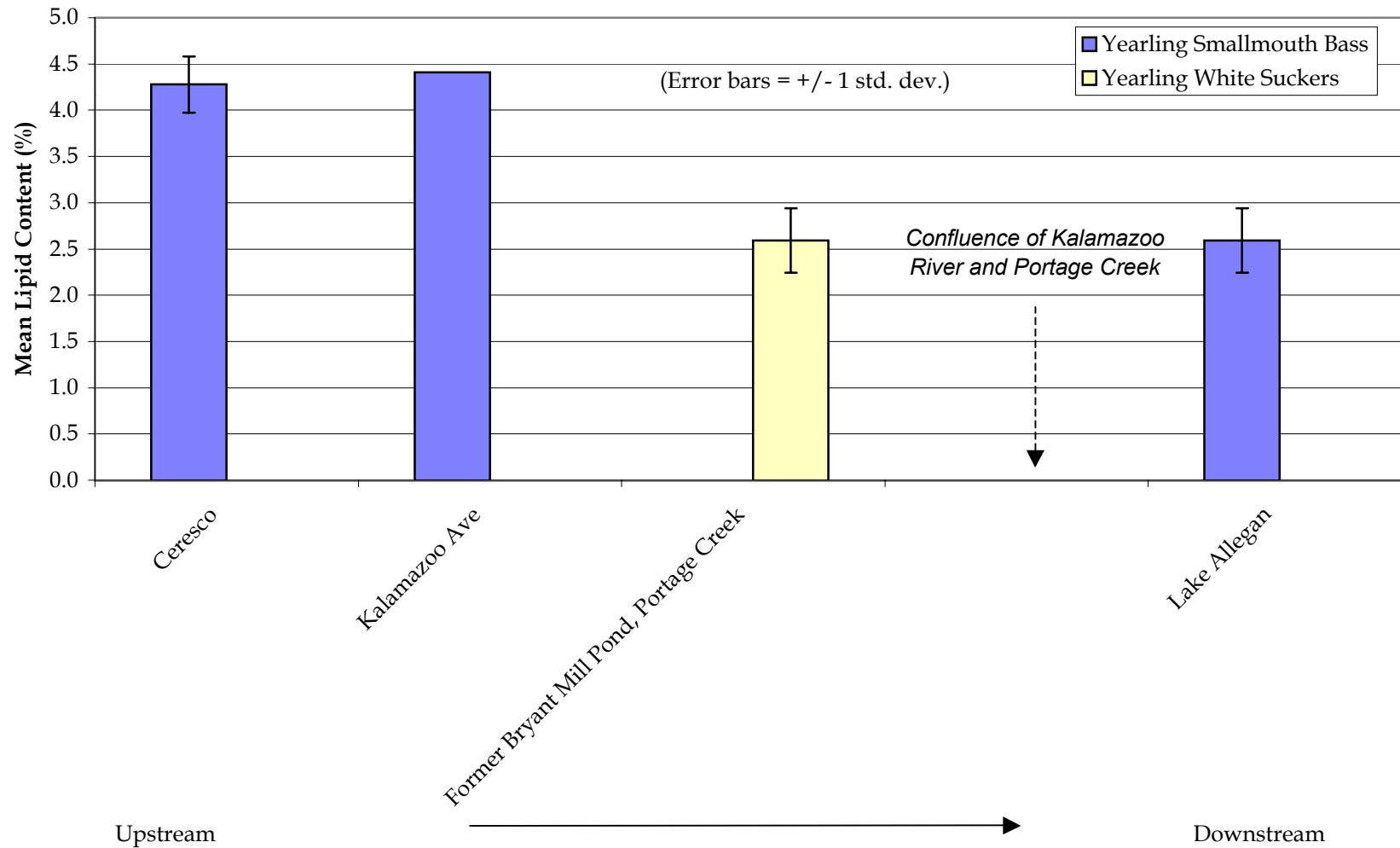


Table 3.11
Total PCB Concentrations (Congeners) and Tissue Lipid
Concentrations in 2000 Yearling Fish: Upstream to Downstream Locations

SampleID	Weight (g)	Total PCBs (mg/kg ww)	Lipid Content (%)	Total PCBs (mg/kg L-N)
Yearling Smallmouth Bass - Ceresco Reservoir				
FW-031-0-23	43.5	0.16	4.58	3.58
FW-031-0-24	47	0.15	3.89	3.87
FW-031-0-25	46.7	0.15	4.34	3.38
FW-031-0-26	43.2	0.15	4.04	3.83
FW-031-0-27	58.7	0.17	4.54	3.78
Yearling Smallmouth Bass - Kalamazoo Avenue				
FW-062-0-18	31.8	1.27	4.41	28.75
Yearling Smallmouth Bass - Lake Allegan				
FW-030-0-25	47.9	1.42	2.76	51.53
FW-030-0-28	44.5	1.20	3.16	37.84
FW-030-0-29	50.2	1.38	3.67	37.71
FW-030-0-30	56.3	1.31	3.21	40.80
FW-030-0-31	54.7	1.19	3.11	38.32
Yearling White Suckers - Portage Creek - Former Bryant Mill Pond				
FW-061-0-01	166.2	0.58	2.54	23.01
FW-061-0-02	50	0.52	2.07	25.24
FW-061-0-03	37	0.49	2.96	16.56
FW-061-0-04	67	0.45	2.86	15.72
FW-061-0-05	19	0.48	2.54	19.05

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Whole Resident Fish); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is not a transect) and DD is the sequential fish number

Table 3.12 Mean Total Wet-Weight PCB Concentrations (Congeners) in
Resident Yearling Fish: Upstream to Downstream Locations

Location	Station No.	Min/Max Total PCBs (mg/kg ww)	Mean Total PCBs (mg/kg ww)	Standard Deviation (mg/kg ww)	Relative Standard Deviation (%)
Yearling Smallmouth Bass					
Ceresco Reservoir	031	0.15 / 0.17	0.16	0.01	6
Kalamazoo Avenue	062	N/A	1.27	N/A	N/A
Lake Allegan	030	1.19 / 1.42	1.30	0.11	8
<i>Mean RSD</i>					7
Yearling White Suckers					
Portage Creek - Former Bryant Mill Pond	061	0.45 / 0.58	0.51	0.05	10

Resident Yearling Fish: Upstream to Downstream Locations

Location	Station No.	Min/Max Total PCBs (mg/kg L-N)	Mean Total PCBs (mg/kg L-N)	Standard Deviation (mg/kg L-N)	Relative Standard Deviation (%)
Yearling Smallmouth Bass					
Ceresco Reservoir	031	3.38 / 3.87	3.69	0.20	6
Kalamazoo Avenue	062	N/A	28.75	N/A	N/A
Lake Allegan	030	37.71 / 51.53	41.24	5.89	14
<i>Mean RSD</i>					10
Yearling White Suckers					
Portage Creek - Former Bryant Mill Pond	061	15.72 / 25.24	19.91	4.11	21

Resident Yearling Fish: Upstream to Downstream Locations

Location	Station No.	Min/Max Lipid Content (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Yearling Smallmouth Bass					
Ceresco Reservoir	031	3.89 / 4.58	4.28	0.30	7
Kalamazoo Avenue	062	N/A	4.41	N/A	N/A
Lake Allegan	030	2.76 / 3.67	3.18	0.33	10
<i>Mean RSD</i>					9
Yearling White Suckers					
Portage Creek - Former Bryant Mill Pond	061	2.07 / 2.96	2.59	0.35	13

Adult Smallmouth Bass

Figures

Tables

**Figure 3.19. Mean Total PCBs (Aroclors) in 2000 Adult Smallmouth Bass
(n=11, except n=10 at Lake Allegan)
(Wet-Weight Data)**

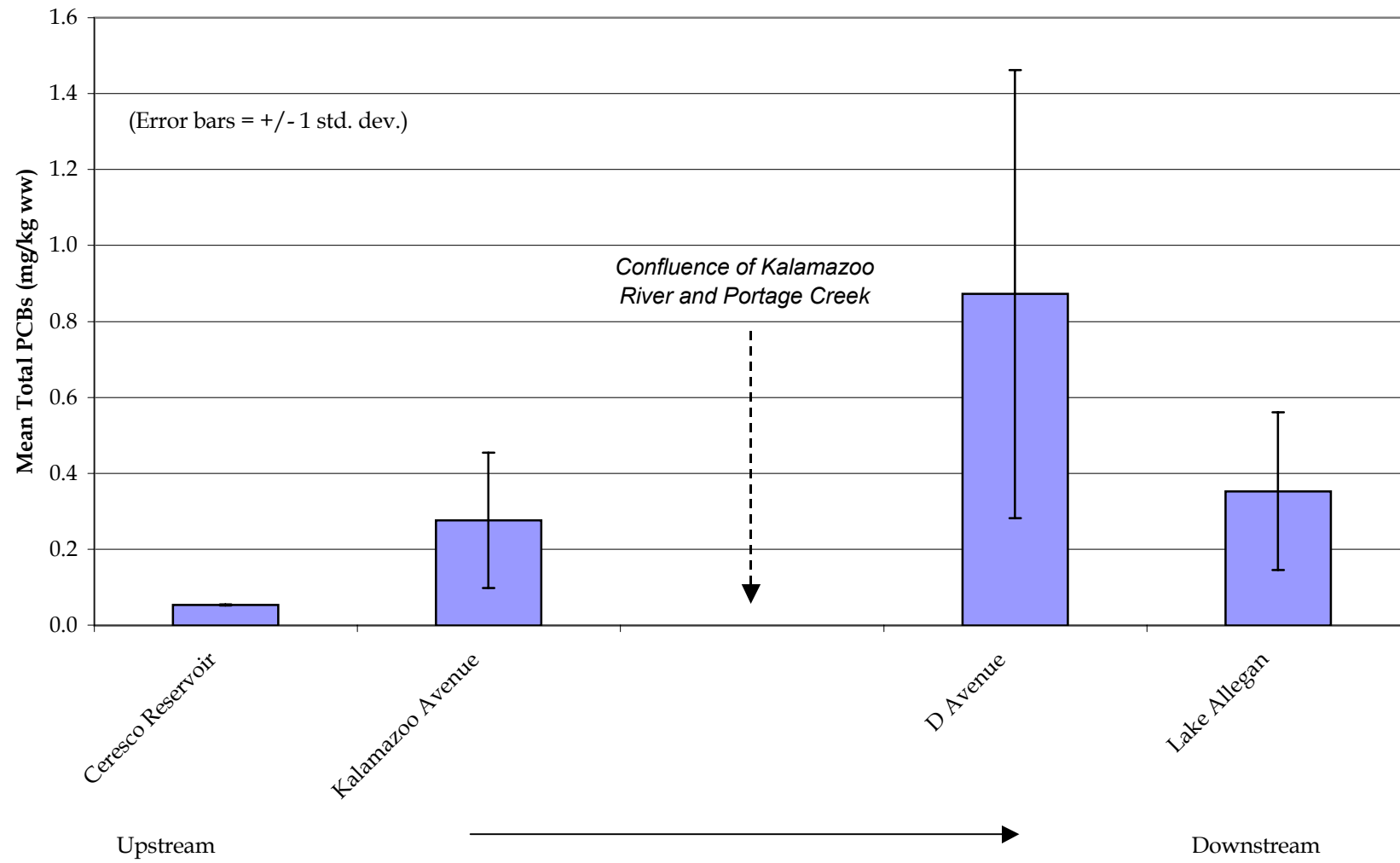


Figure 3.20. Mean Total PCBs in 2000 Adult Smallmouth Bass
(n=11, except n=10 at Lake Allegan)
(Lipid-Normalized Data)

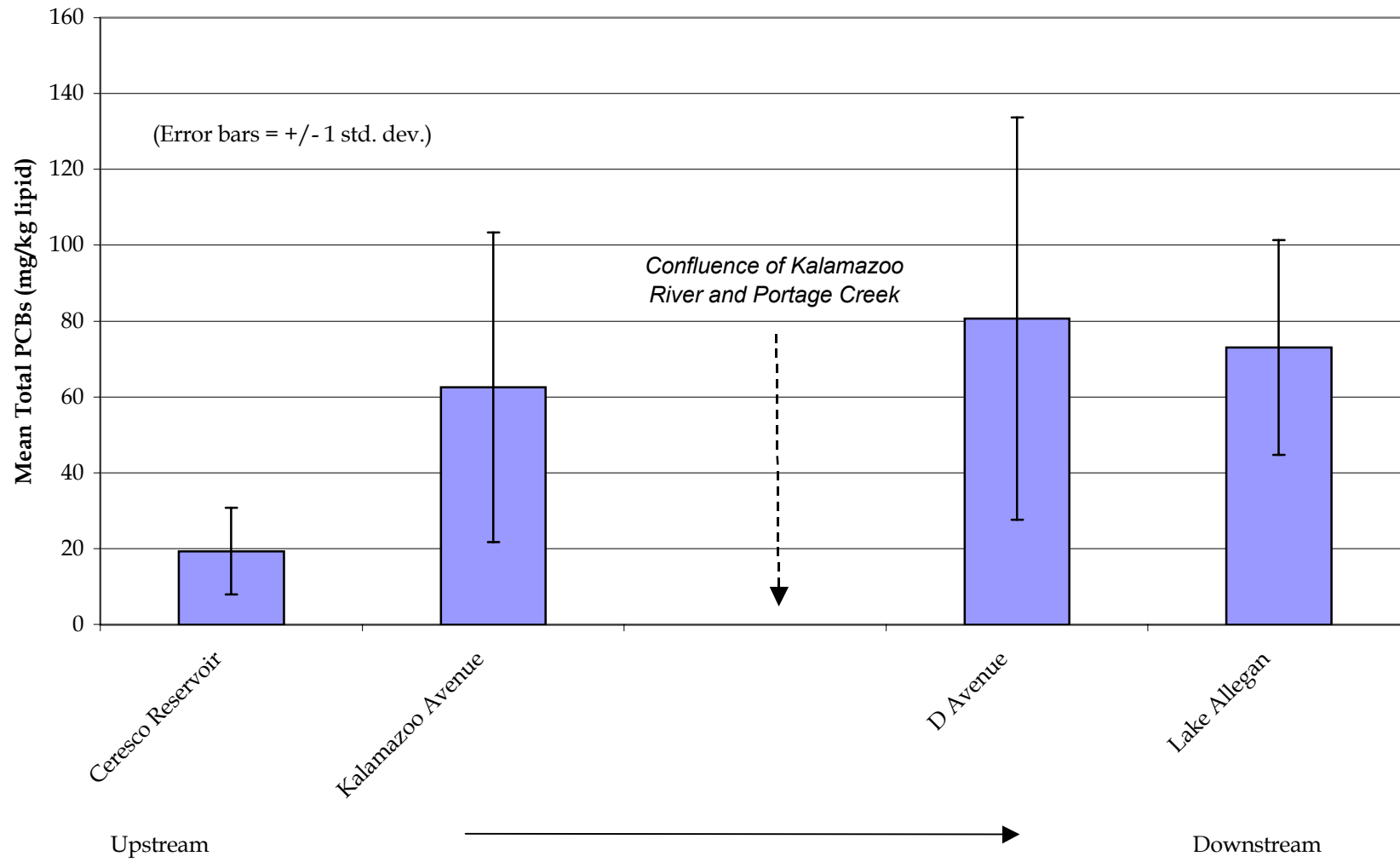


Figure 3.21. Tissue Lipid Content in 2000 Adult Smallmouth Bass
(n=11, except n=10 at Lake Allegan)

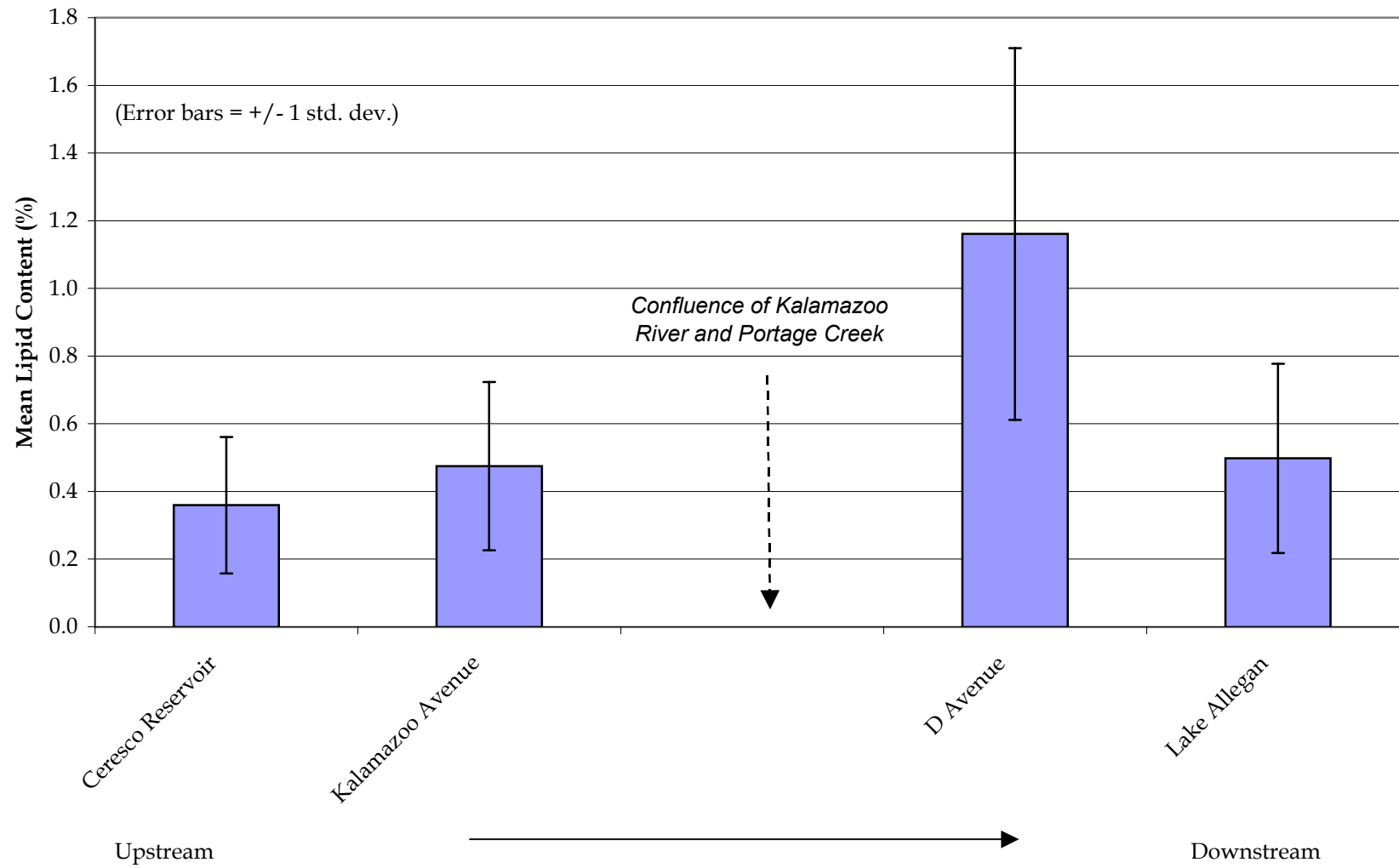


Table 3.15
Total PCB Concentrations (Aroclors) and Tissue Lipid Concentrations in
Resident Adult Smallmouth Bass: Upstream to Downstream Locations

SampleID	Length (cm)	Weight (g)	Total PCBs (mg/kg ww)	Lipid Content (%)	Total PCBs (mg/kg L-N)
Ceresco Reservoir					
FW-031-0-12	38.8	793.8	0.05	0.51	10.47
FW-031-0-13	38.2	708.7	0.05	0.11	47.50
FW-031-0-14	33.5	538.6	0.05	0.16	31.22
FW-031-0-15	34.5	623.7	0.05	0.29	18.51
FW-031-0-16	24.2	226.8	0.05	0.36	14.71
FW-031-0-17	29.5	425.2	0.05	0.86	5.86
FW-031-0-18	32.5	567	0.05	0.34	15.01
FW-031-0-19	23.4	226.8	0.05	0.45	12.04
FW-031-0-20	30.1	425.2	0.05	0.27	20.22
FW-031-0-21	23.6	226.8	0.06	0.36	15.50
FW-031-0-22	28.4	340.2	0.05	0.25	21.05
Kalamazoo Avenue					
FW-062-0-03	35.9	538.6	0.50	0.82	60.77
FW-062-0-04	31.6	396.9	0.57	0.36	160.56
FW-062-0-05	32.8	396.9	0.39	0.72	53.52
FW-062-0-06	27.3	255.1	0.06	0.14	46.15
FW-062-0-11	31.1	340.2	0.21	0.34	60.55
FW-062-0-12	31.2	340.2	0.07	0.18	40.00
FW-062-0-13	28.1	283.5	0.14	0.56	24.87
FW-062-0-15	27	226.8	0.09	0.43	21.13
FW-062-0-16	27	226.8	0.34	0.78	42.86
FW-062-0-17	26.7	170.1	0.26	0.23	114.37
FW-062-0-19	26.2	226.8	0.42	0.67	62.62
D Avenue					
FW-063-0-01	39.5	708.7	2.35	1.06	221.42
FW-063-0-02	31.7	255.1	0.74	1.47	50.03
FW-063-0-03	29.5	255.1	0.61	1.19	51.45
FW-063-0-04	28.9	283.5	0.78	1.26	61.59
FW-063-0-05	29.4	311.8	0.46	0.88	51.99
FW-063-0-06	37.2	510.3	0.46	0.79	58.47
FW-063-0-07	32.7	396.9	0.85	1.52	55.94
FW-063-0-08	29.3	311.8	1.21	1.66	72.77
FW-063-0-09	27.5	198.4	0.20	0.32	62.42
FW-063-0-10	28	283.5	1.35	2.19	61.78
FW-063-0-11	30.5	255.1	0.59	0.42	139.83
Lake Allegan					
FW-030-0-05	26.3	283.5	0.33	0.75	43.27
FW-030-0-06	30.4	340.2	0.40	0.41	98.47
FW-030-0-07	29.5	368.5	0.14	0.36	38.48
FW-030-0-08	29	311.8	0.43	0.74	57.75
FW-030-0-18	31.6	396.9	0.53	0.50	106.63
FW-030-0-19	33.7	453.6	0.24	0.30	79.77
FW-030-0-20	26.6	226.8	0.21	0.27	78.10
FW-030-0-21	31.6	425.2	0.10	0.25	38.76
FW-030-0-22	25.6	170.1	0.35	0.30	116.27
FW-030-0-27	24.5	170.1	0.80	1.10	73.12

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Whole Resident Fish); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is not a transect) and DD is the sequential fish number

Table 3.16
Mean Total Wet-Weight PCB Concentrations (Aroclors) in Resident
Adult Smallmouth Bass: Upstream to Downstream Locations

Location	Station No.	Min/Max Total PCBs (mg/kg ww)	Mean Total PCBs (mg/kg ww)	Standard Deviation (mg/kg ww)	Relative Standard Deviation (%)
Ceresco Reservoir	031	0.05 / 0.06	0.05	0.00	3
Kalamazoo Avenue	062	0.06 / 0.57	0.28	0.18	64
D Avenue	063	0.20 / 2.35	0.87	0.59	68
Lake Allegan	030	0.10 / 0.80	0.35	0.21	59
Mean RSD					49

Table 3.17
Mean Total Lipid Normalized PCB Concentrations in
Resident Smallmouth Bass: Upstream to Downstream Locations

Location	Station No.	Min/Max Total PCBs (mg/kg L-N)	Mean Total PCBs (mg/kg L-N)	Standard Deviation (mg/kg L-N)	Relative Standard Deviation (%)
Ceresco Reservoir	031	5.86 / 47.50	19.28	11.43	59
Kalamazoo Avenue	062	21.13 / 160.56	62.49	40.84	65
D Avenue	063	50.03 / 221.42	80.70	53.05	66
Lake Allegan	030	38.48 / 116.27	73.06	28.29	39
Mean RSD					57

Table 3.18
Mean Tissue Lipid Concentrations in
Resident Adult Smallmouth Bass: Upstream to Downstream Locations

Location	Station No.	Min/Max Lipid Content (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Ceresco Reservoir	031	0.11 / 0.86	0.36	0.20	56
Kalamazoo Avenue	062	0.14 / 0.82	0.47	0.25	52
D Avenue	063	0.32 / 2.19	1.16	0.55	47
Lake Allegan	030	0.25 / 1.10	0.50	0.28	56
Mean RSD					53

Adult Carp

Figures
Tables

**Figure 3.22. Mean Total PCBs (Aroclors) in 2000 Adult Carp
(n=11, except n=6 at Kalamazoo Avenue and n=5 at D Avenue)
(Wet-Weight Data)**

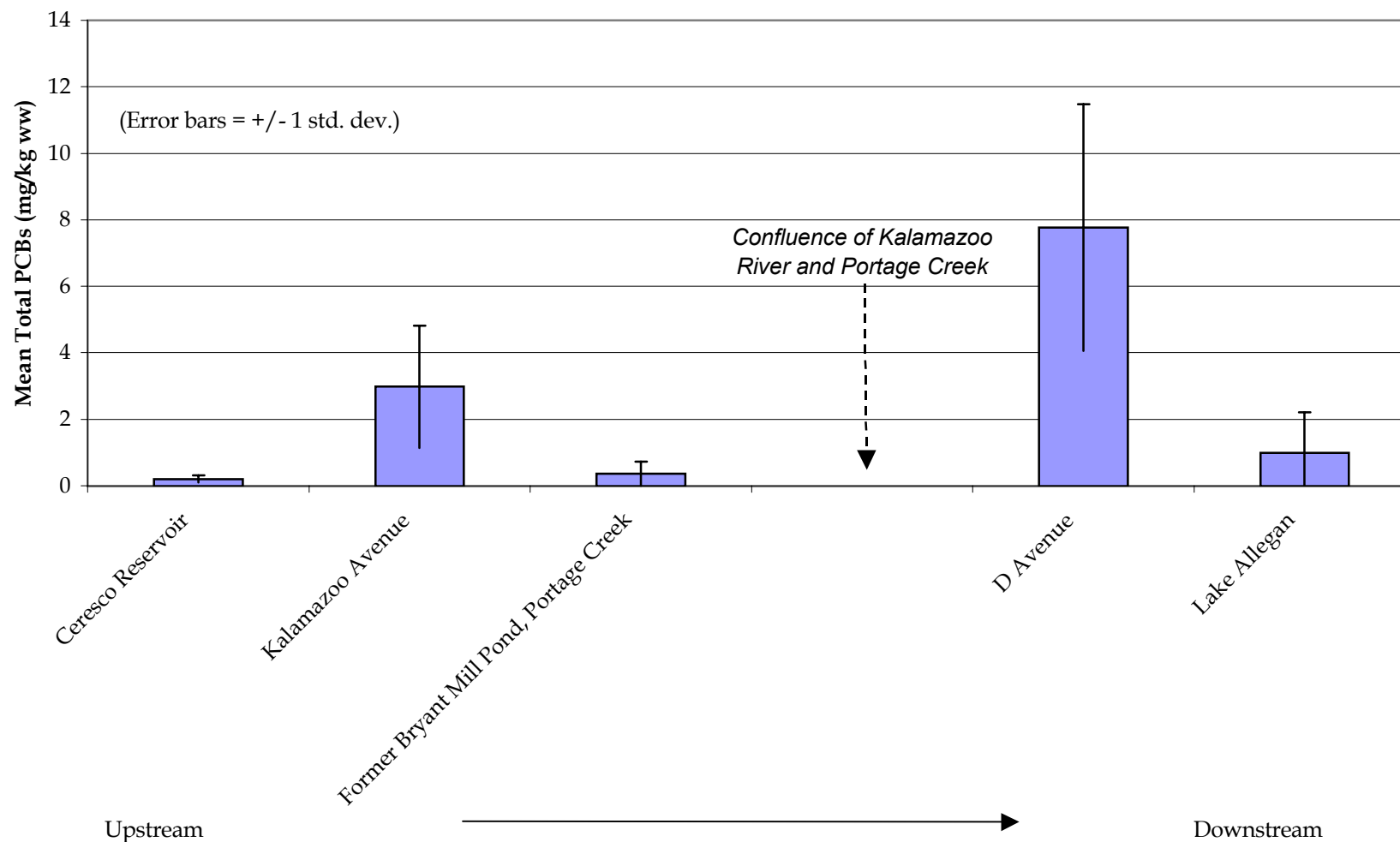


Figure 3.23. Mean Total PCBs in 2000 Adult Carp
(n=11, except n=6 at Kalamazoo Avenue and n=5 at D Avenue)
(Lipid-Normalized Data)

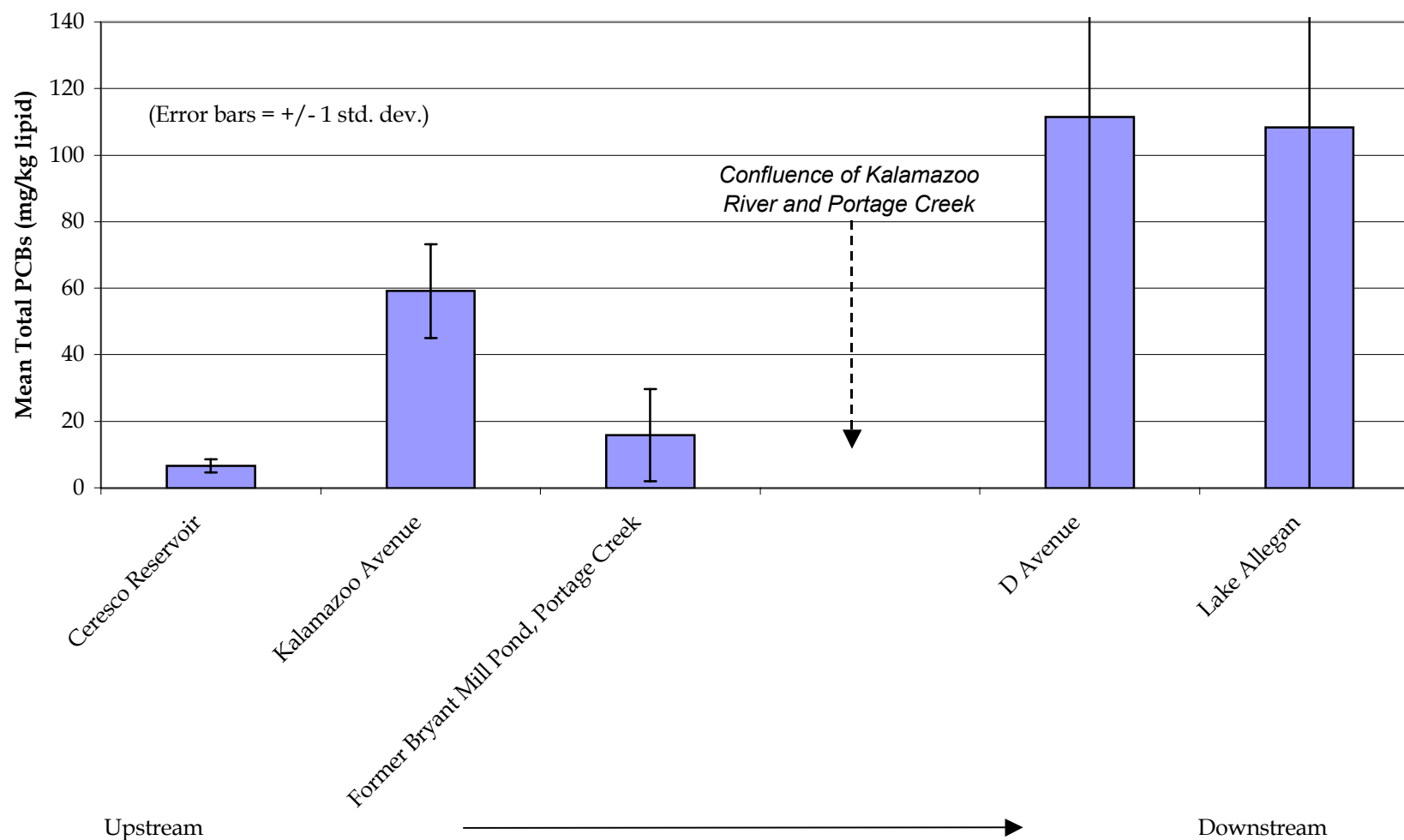


Figure 3.24. Tissue Lipid Content in 2000 Adult Carp
(n=11, except n=6 at Kalamazoo Avenue and n=5 at D Avenue)

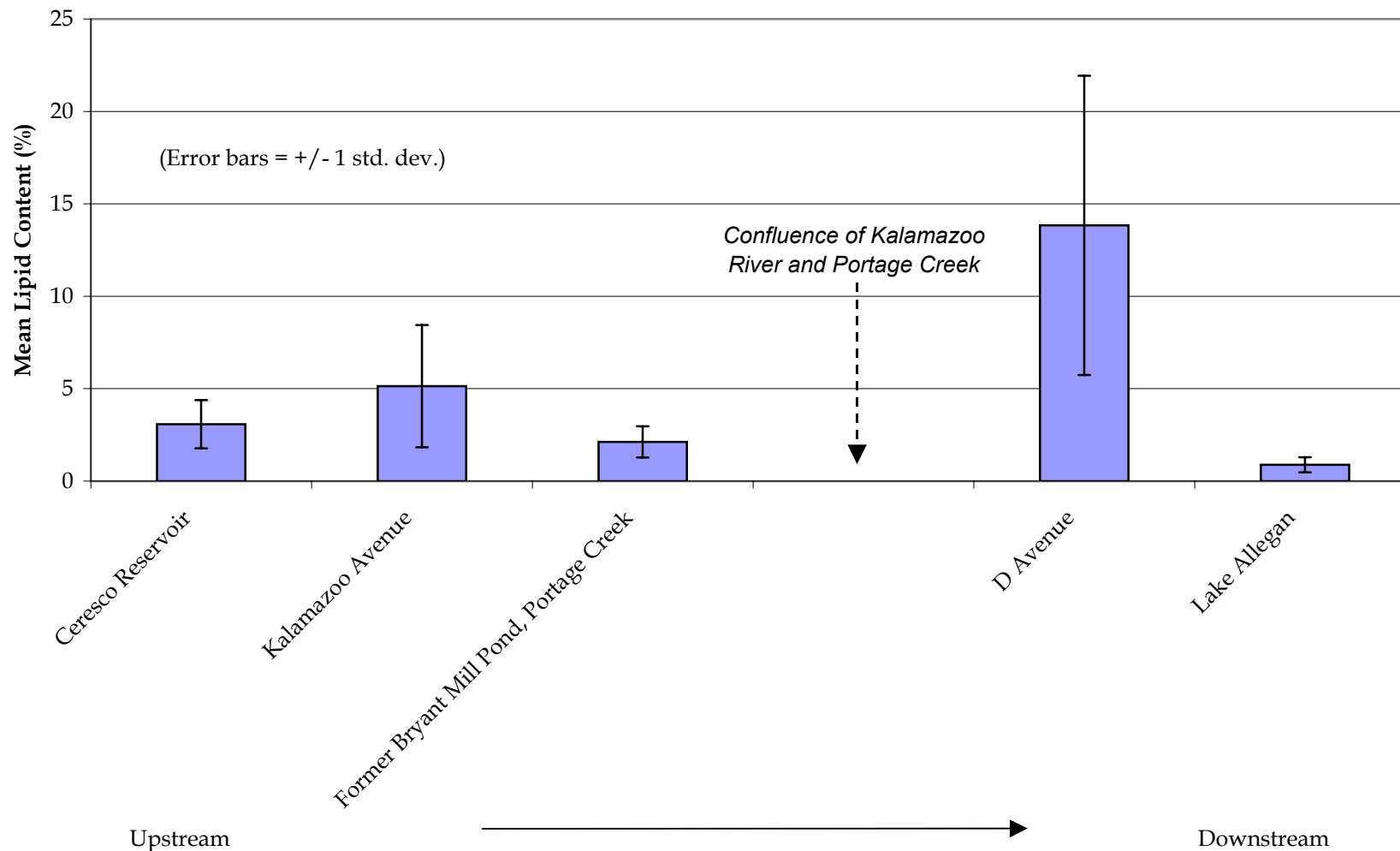


Table 3.19
Total PCB Concentrations (Aroclors) and Tissue Lipid Concentrations in
Resident Adult Carp: Upstream to Downstream Locations

SampleID	Length (cm)	Weight (g)	Total PCBs (mg/kg ww)	Lipid Content (%)	Total PCBs (mg/kg L-N)
Ceresco Reservoir					
FW-031-0-01	61.8	3543.7	0.38	5.48	6.87
FW-031-0-02	57.6	2778.2	0.11	1.72	6.22
FW-031-0-03	54	2154.6	0.22	2.78	8.03
FW-031-0-04	58.5	3203.5	0.08	1.73	4.88
FW-031-0-05	59.2	2806.6	0.37	4.25	8.71
FW-031-0-06	50.4	2012.8	0.11	4.79	2.28
FW-031-0-07	58.4	3401.9	0.23	2.82	8.15
FW-031-0-08	57.4	3146.8	0.20	2.78	7.19
FW-031-0-09	57.4	3090.1	0.23	2.76	8.28
FW-031-0-10	60	3543.7	0.06	1.37	4.64
FW-031-0-11	57.9	2948.4	0.26	3.34	7.66
Kalamazoo Avenue					
FW-062-0-01	66.5	4337.5	6.21	11.50	54.02
FW-062-0-02	58.1	2551.5	1.97	3.66	53.80
FW-062-0-07	56.2	2154.6	2.03	2.89	70.24
FW-062-0-08	52.1	1871.1	1.30	3.63	35.73
FW-062-0-09	53.7	1927.8	4.09	5.97	68.49
FW-062-0-10	45.5	1247.4	2.29	3.16	72.47
Portage Creek - Former Bryant Mill Pond					
FW-061-0-06	60	3402	1.25	2.60	48.00
FW-061-0-08	54	2268	0.05	1.41	3.81
FW-061-0-09	61.3	3061.7	0.44	1.95	22.79
FW-061-0-10	52.1	2041.2	0.05	1.46	3.73
FW-061-0-11	50.2	1984.5	0.06	1.01	5.46
FW-061-0-12	59.7	2920	0.22	2.44	9.03
FW-061-0-13	50.5	1701	0.27	1.58	16.79
FW-061-0-14	51.8	2381.4	0.17	1.67	10.26
FW-061-0-15	56	2721.6	0.73	2.44	29.96
FW-061-0-16	58.2	3685.4	0.56	2.74	20.29
FW-061-0-17	53.3	2211.3	0.17	4.02	4.35
D Avenue					
FW-063-0-12	75.6	6208.5	8.58	16.80	51.04
FW-063-0-13	69	3628.7	1.25	0.37	334.68
FW-063-0-14	67.2	5499.8	10.34	21.70	47.65
FW-063-0-15	88.9	7541	9.82	17.00	57.74
FW-063-0-16	80.65	8675	8.83	13.30	66.42
Lake Allegan					
FW-030-0-01	45.6	1247.4	1.47	0.98	150.87
FW-030-0-02	49.9	1530.9	0.56	1.29	43.24
FW-030-0-03	47.1	1219	0.30	0.59	50.08
FW-030-0-04	46	1190.7	0.53	0.93	56.71
FW-030-0-11	45.6	1048.9	0.05	0.30	17.53
FW-030-0-12	47.9	1502.5	1.04	1.48	70.34
FW-030-0-13	45.7	1502.5	1.74	1.54	112.86
FW-030-0-14	47.1	1304.1	4.28	0.78	549.87
FW-030-0-15	46	1077.3	0.19	0.50	37.43
FW-030-0-16	48.2	1304.1	0.39	0.61	63.86
FW-030-0-17	43.8	1134	0.27	0.70	38.07

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Whole Resident Fish); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is not a transect) and DD is the sequential fish number

Table 3.20
Mean Total Wet-Weight PCB Concentrations (Aroclors) in
Resident Adult Carp: Upstream to Downstream Locations

Location	Station No.	Min/Max Total PCBs (mg/kg ww)	Mean Total PCBs (mg/kg ww)	Standard Deviation (mg/kg ww)	Relative Standard Deviation (%)
Ceresco Reservoir	031	0.06 / 0.38	0.20	0.11	52
Kalamazoo Avenue	062	1.30 / 6.21	2.98	1.84	62
Portage Creek - Former Bryant Mill Pond	061	0.05 / 1.25	0.36	0.37	102
D Avenue	063	1.25 / 10.34	7.76	3.71	48
Lake Allegan	030	0.05 / 4.28	0.98	1.22	124
Mean RSD					78

Table 3.21
Mean Total Lipid Normalized PCB Concentrations in
Resident Adult Carp: Upstream to Downstream Locations

Location	Station No.	Min/Max Total PCBs (mg/kg L-N)	Mean Total PCBs (mg/kg L-N)	Standard Deviation (mg/kg L-N)	Relative Standard Deviation (%)
Ceresco Reservoir	031	2.28 / 8.71	6.63	1.97	30
Kalamazoo Avenue	062	35.73 / 72.47	59.12	14.08	24
Portage Creek - Former Bryant Mill Pond	061	3.73 / 48.00	15.86	13.82	87
D Avenue	063	47.65 / 334.68	111.51	124.96	112
Lake Allegan	030	17.53 / 549.87	108.26	151.23	140
Mean RSD					78

Table 3.22
Mean Tissue Lipid Concentrations in
Resident Adult Carp: Upstream to Downstream Locations

Location	Station No.	Min/Max Lipid Content (%)	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Ceresco Reservoir	031	1.37 / 5.48	3.07	1.31	42
Kalamazoo Avenue	062	2.89 / 11.50	5.14	3.30	64
Portage Creek - Former Bryant Mill Pond	061	1.01 / 4.02	2.12	0.84	40
D Avenue	063	0.37 / 21.70	13.83	8.10	59
Lake Allegan	030	0.30 / 1.54	0.88	0.41	46
Mean RSD					50

Other Fish

Figures

Tables

Figure 3.25. Total PCB Concentrations (Aroclors) for Other Fish Species, 2000
(Wet-Weight Data)

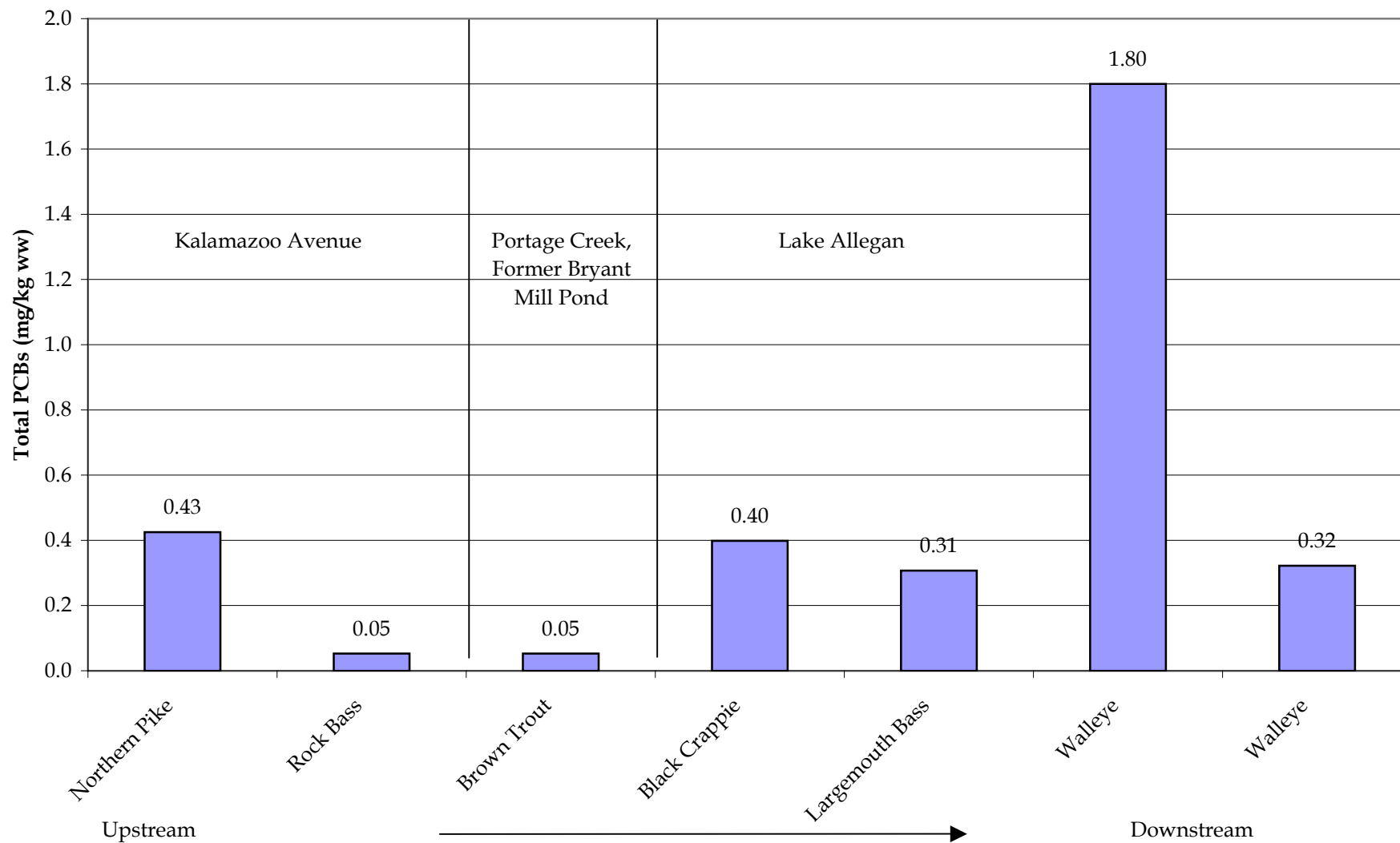


Figure 3.26. Total PCB Concentrations for Other Fish Species, 2000
(Lipid-Normalized Data)

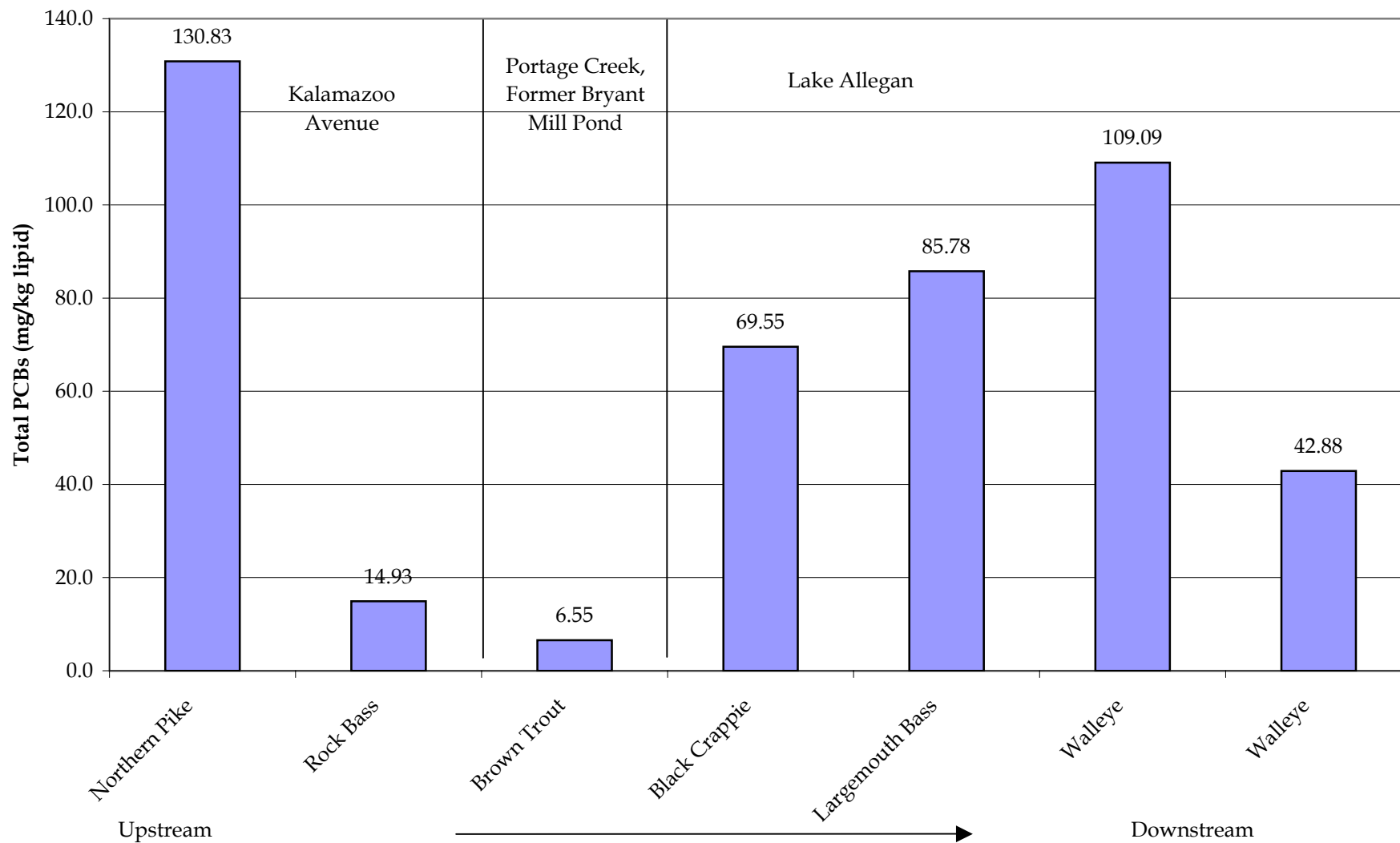


Figure 3.27. Tissue Lipid Content for Other Fish Species, 2000

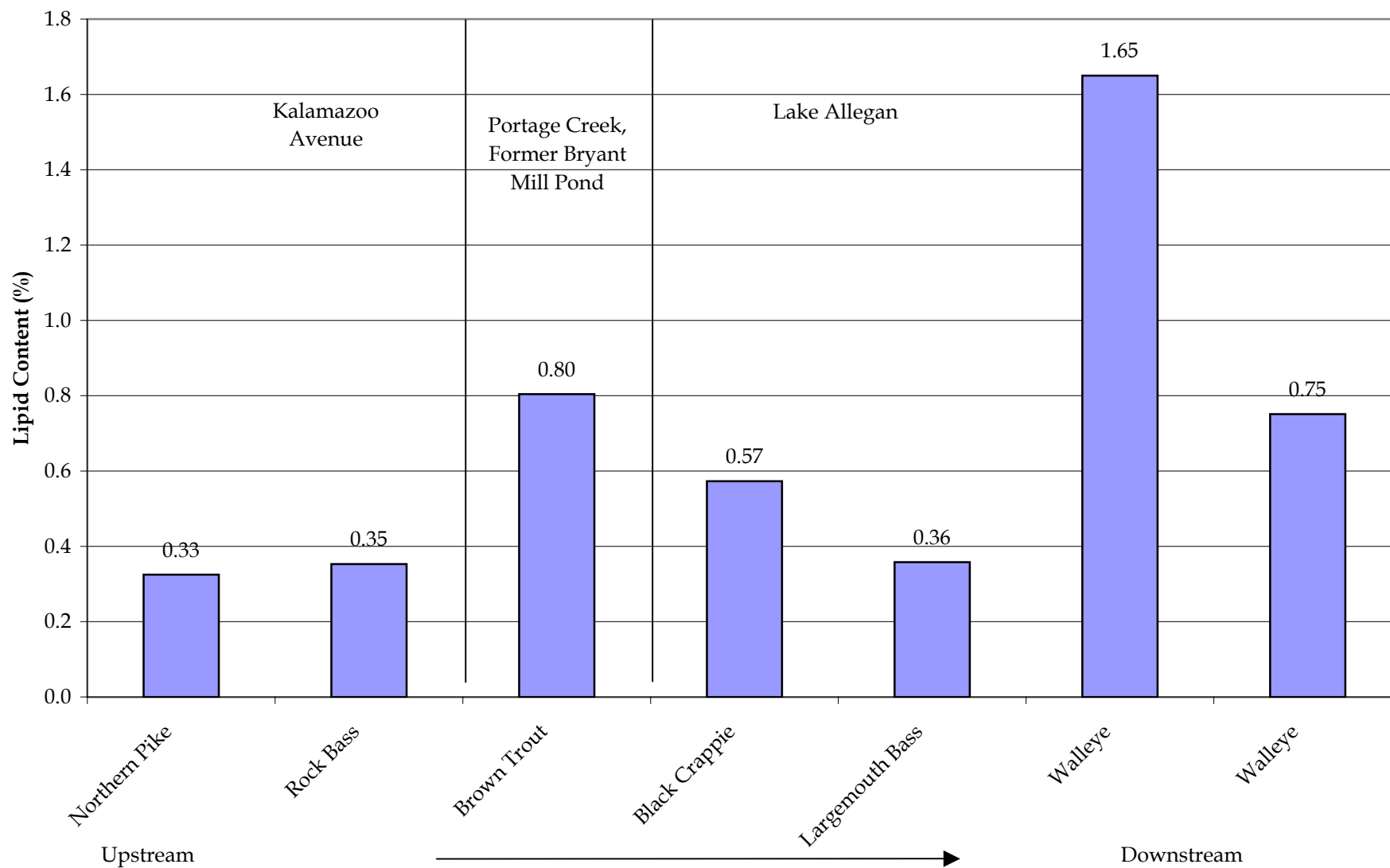


Table 3.23
Mean Total, Wet-Weight, Lipid-Normalized PCB Concentrations (Aroclors) and Percent Lipid in Other Adult Fish
Species: Upstream to Downstream Locations

SampleID	Location	Species	Length (cm)	Weight (g)	Total PCBs (mg/kg ww)	Lipid Content (%)	Total PCBs (mg/kg L-N)
FW-062-0-20	Kalamazoo Avenue	Northern Pike	64.57	1474.2	0.43	0.33	130.83
FW-062-0-14	Kalamazoo Avenue	Rock Bass	21.5	226.8	0.05	0.35	14.93
FW-061-0-07	Portage Creek - Former Bryant Mill Pond	Brown Trout	22	98	0.05	0.80	6.55
FW-030-0-23	Lake Allegan	Black Crappie	28	453.6	0.40	0.57	69.55
FW-030-0-24	Lake Allegan	Largemouth Bass	44	1304.1	0.31	0.36	85.78
FW-030-0-09	Lake Allegan	Walleye	59.3	1956.1	1.80	1.65	109.09
FW-030-0-10	Lake Allegan	Walleye	44	1786	0.32	0.75	42.88

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Whole Resident Fish); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is not a transect) and DD is the sequential fish number

Bedded Sediment

Figures

Tables

Figure 3.28. Sediment PCB Concentrations (Congeners) from the 2000 Resident Fish Sampling Sites

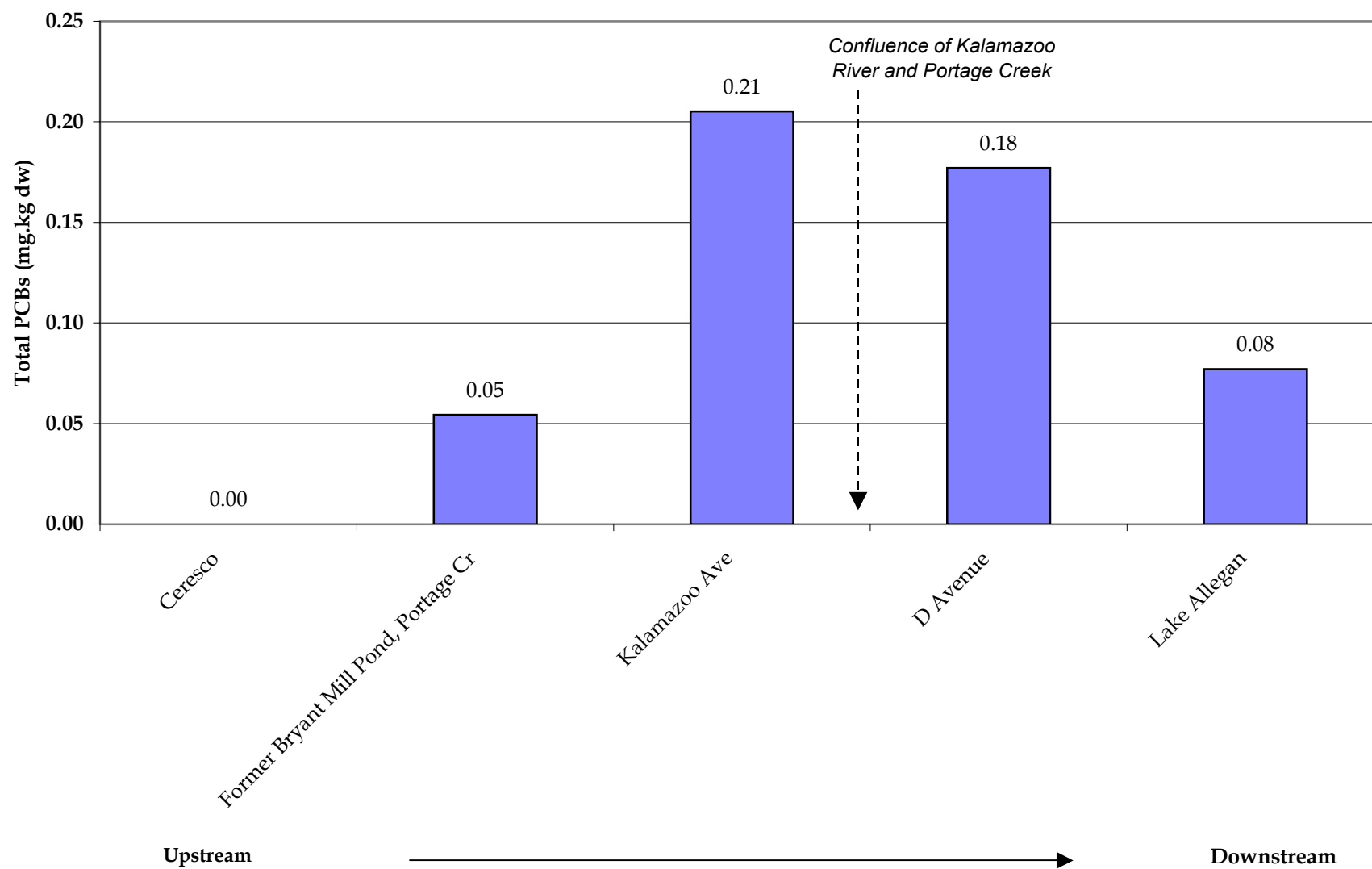


Table 3.24
Total PCB Concentrations (Congeners) in the Sediments
Collected During the 2000 Resident Fish Survey

SampleID ¹	Location	Total PCBs (mg/kg ww)	TOC (mg/kg)
BS-031-0-01A	Ceresco Reservoir	0.00	30400
BS-062-0-01	Kalamazoo Avenue	0.205	< 8.39
BS-061-0-01	Portage Creek - Former Bryant Mill Pond	0.054	3260
BS-063-0-01	D Avenue	0.177	< 1680
BS-030-0-01A	Lake Allegan	0.077	4460

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (BS-Bedded Sediment); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is No Transect); and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

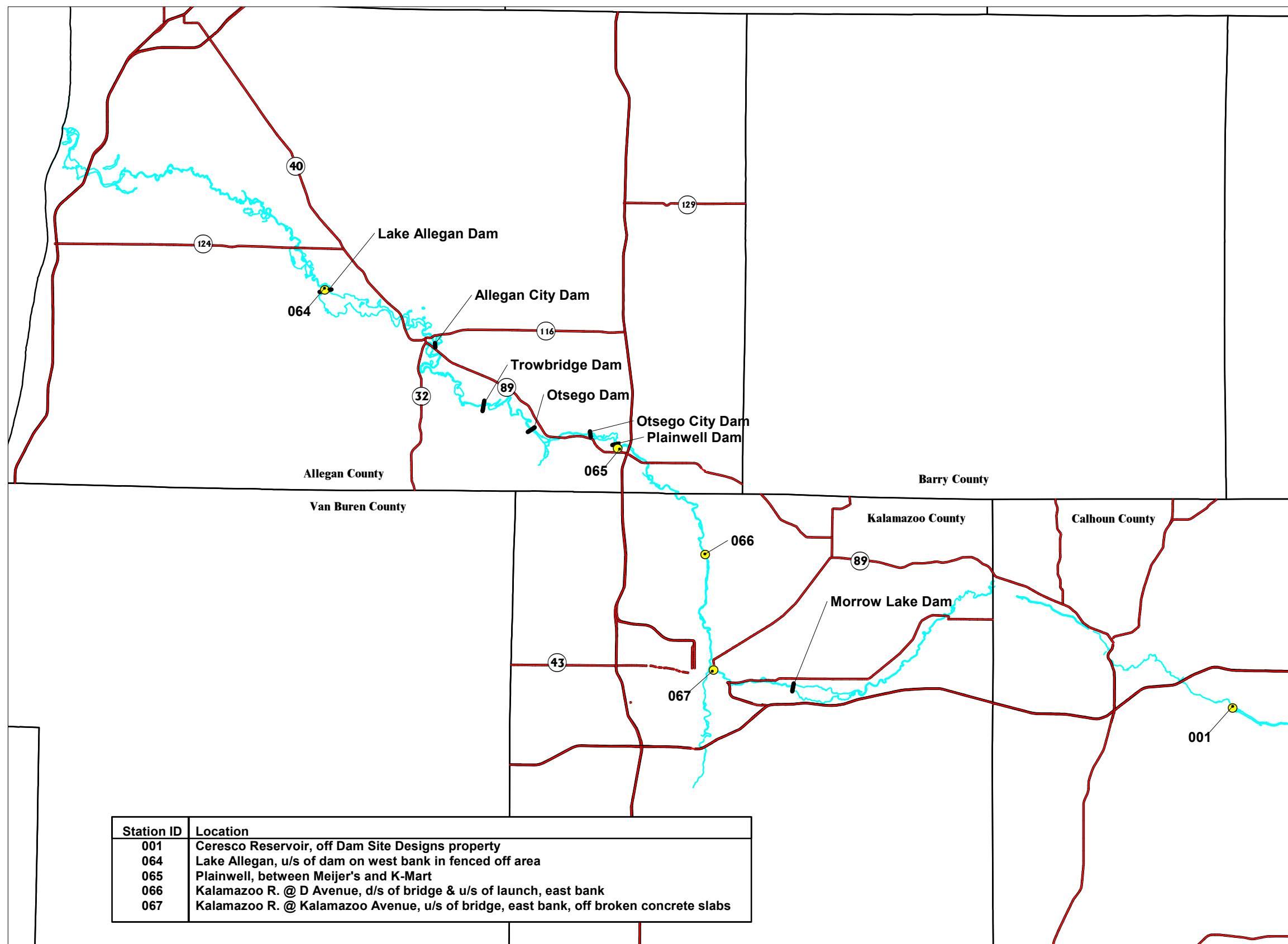
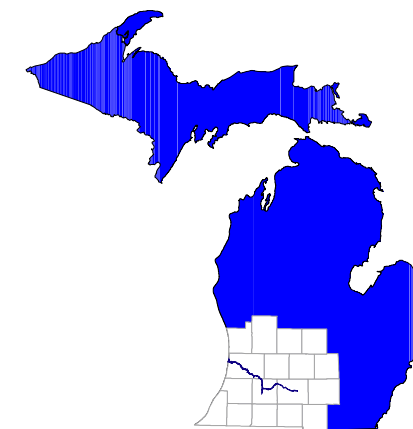
Caged Fish and SPMD Study

Caged Fish Surface Water Samples

Caged Fish

SPMDs

Fish Aging



Station ID	Location
001	Ceresco Reservoir, off Dam Site Designs property
064	Lake Allegan, u/s of dam on west bank in fenced off area
065	Plainwell, between Meijer's and K-Mart
066	Kalamazoo R. @ D Avenue, d/s of bridge & u/s of launch, east bank
067	Kalamazoo R. @ Kalamazoo Avenue, u/s of bridge, east bank, off broken concrete slabs

LEGEND

- Caged Channel Catfish/SPMD Stations
- Dams
- Highways
- County Boundaries
- Portage Creek / Kalamazoo River

0 2 4 6 8 10 Miles

CDM

One Woodward Ave., Suite 1500
Detroit, Michigan 48226
Phone: (313) 963-1313
Fax: (313) 963-3130

Prepared By:
A. Santini
Updated:
1/16/02

**Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site**

**Long Term Monitoring - 2000
Caged Channel Catfish /
SPMD Locations**

**Figure No.
3-29**

Caged Fish Surface Water Samples

Figures

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Figure 3.30. Total PCBs (Congener) in Water Samples Collected During the 2000 Caged Catfish Study
(missing bars = non-detect)

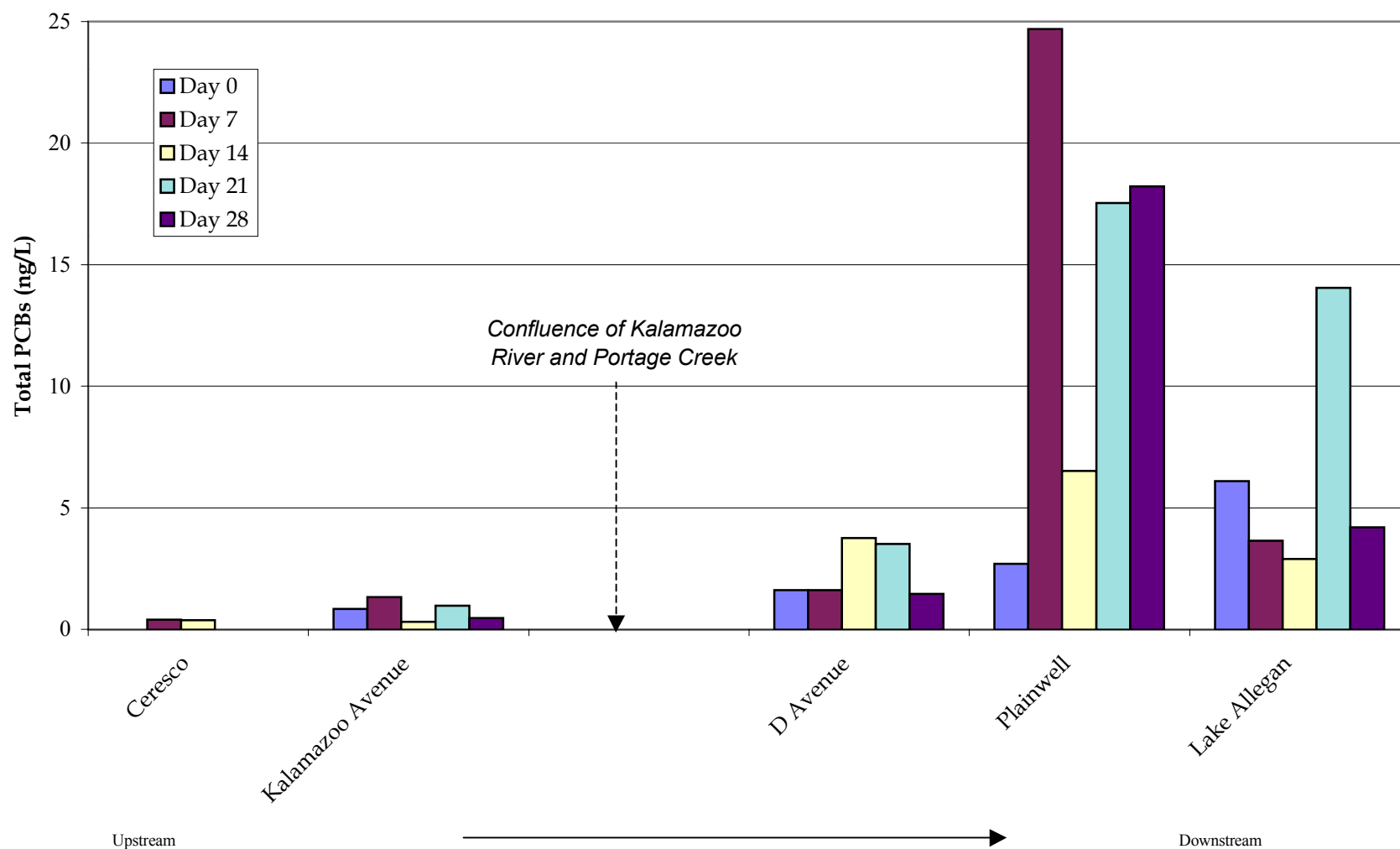


Table 3.25
Total PCB Concentrations (Congeners) in the 2000 Caged Catfish Study Water Samples
Samples collected on Days 0, 7, 14, 21, and 28 of the September 5

SampleID ¹	Exposure Day Collected	Total PCBs (ng/L)	Mean Total PCBs (ng/L) ¹	Standard Deviation (ng/L) ¹	Relative Standard Deviation (%)
Ceresco Reservoir, off Dam Site Designs Property					
CW-001-0-01	0	< 0.20			
CW-001-0-01	7	0.40			
CW-001-0-01	14	0.38			
CW-001-0-01	21	< 0.20			
CW-001-0-01	28	< 0.20	0.22	0.16	73
Kalamazoo R. @ Kalamazoo Avenue, u/s of bridge, east bank, off broken concrete slabs					
CW-067-0-01	0	0.84			
CW-067-0-01	7	1.33			
CW-067-0-01	14	0.31			
CW-067-0-01	21	0.96			
CW-067-0-01	28	0.46	0.78	0.40	52
Kalamazoo R. @ D Avenue, d/s of bridge and u/s of launch, east bank					
CW-066-0-01	0	1.62			
CW-066-0-01	7	1.61			
CW-066-0-01	14	3.76			
CW-066-0-01	21	3.52			
CW-066-0-01	28	1.46	2.39	1.14	48
Plainwell, Between Meiger's and K-Mart					
CW-065-0-01	0	2.69			
CW-065-0-01	7	24.69			
CW-065-0-01	14	6.53			
CW-065-0-01	21	17.54			
CW-065-0-01	28	18.21	13.93	9.06	65
Lake Allegan, u/s of dam on west bank in fenced off area					
CW-064-0-01	0	6.10			
CW-064-0-01	7	3.64			
CW-064-0-01	14	2.89			
CW-064-0-01	21	14.04			
CW-064-0-01	28	4.20	6.17	4.56	74
Mean RSD					62

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (CW-Caged Water); BBB is the sampling station identification number; C is location on transect (looking downstream, where 1 is Left Bank, 2 is mid-Channel, and 3 is Right Bank; and

2. Value used for non-detects in statistical analyses was one-half of the detection limit.

Caged Fish

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Figure 3.31. Mean Total PCBs (Congeners) in 2000 Caged Channel Catfish
(n=4)
(Wet-Weight Data)

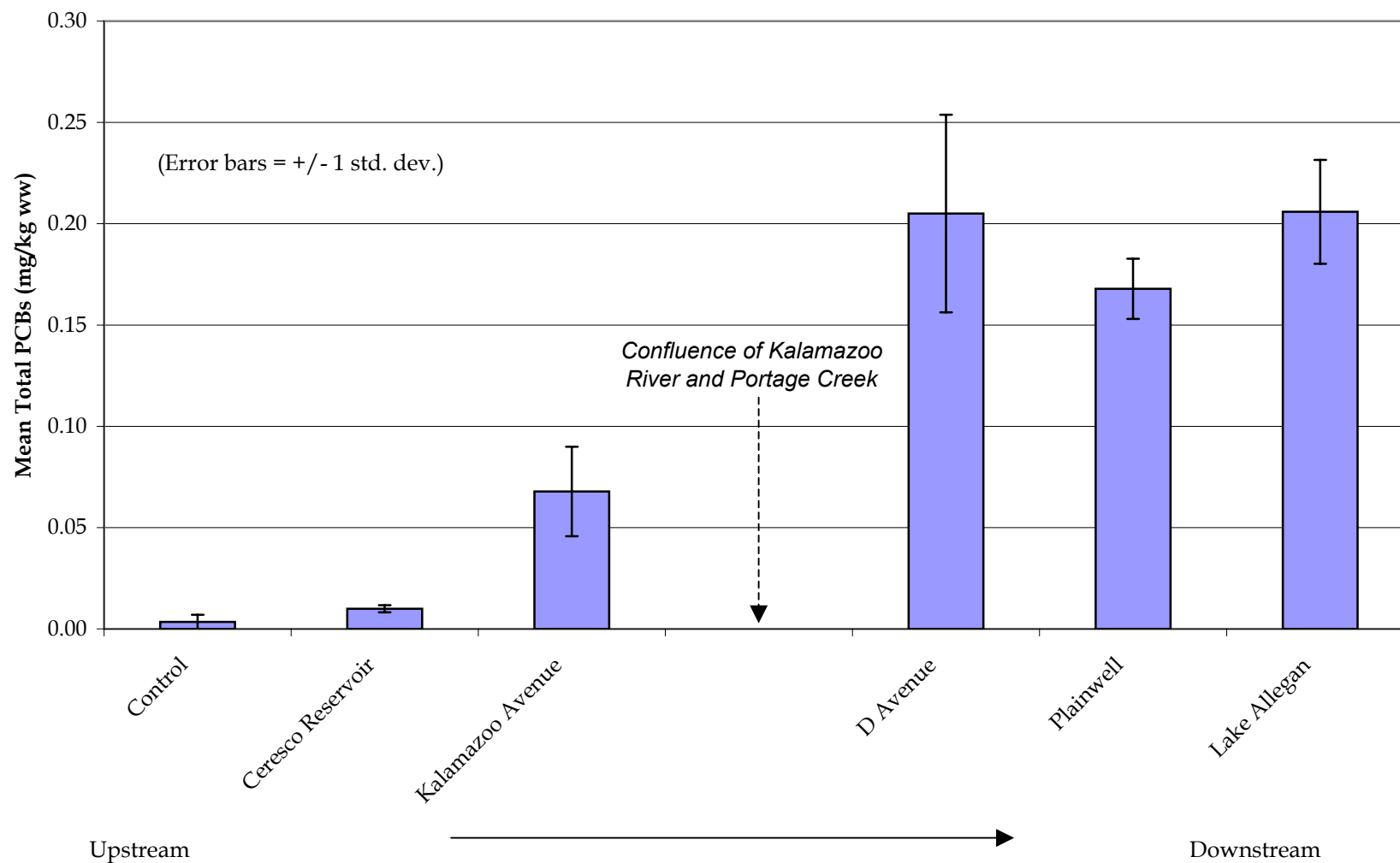


Figure 3.32. Mean Total PCBs in 2000 Caged Channel Catfish
(n=4)
(Lipid-Normalized Data)

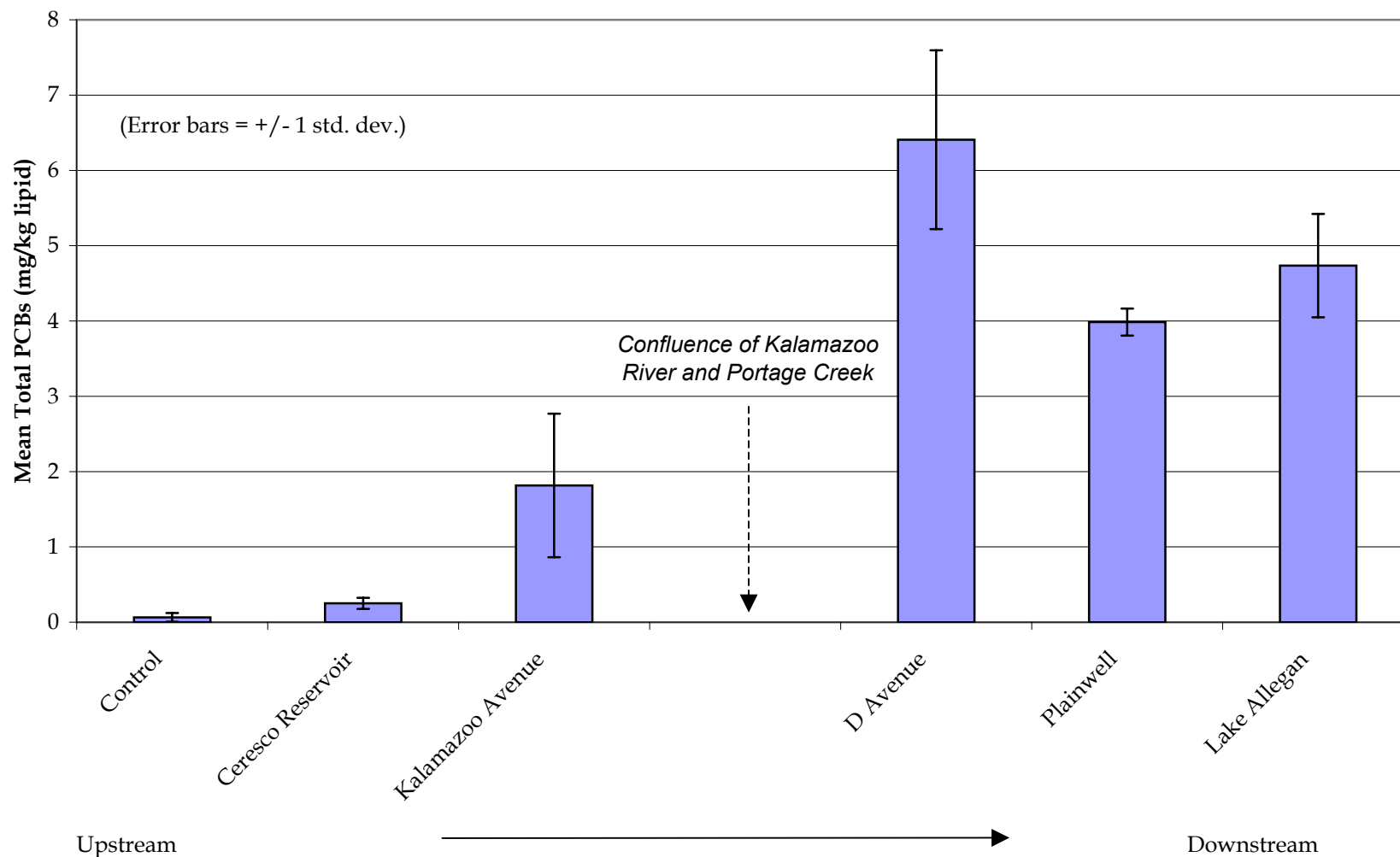


Figure 3.33. Tissue Lipid Content in 2000 Caged Channel Catfish
(n=4)

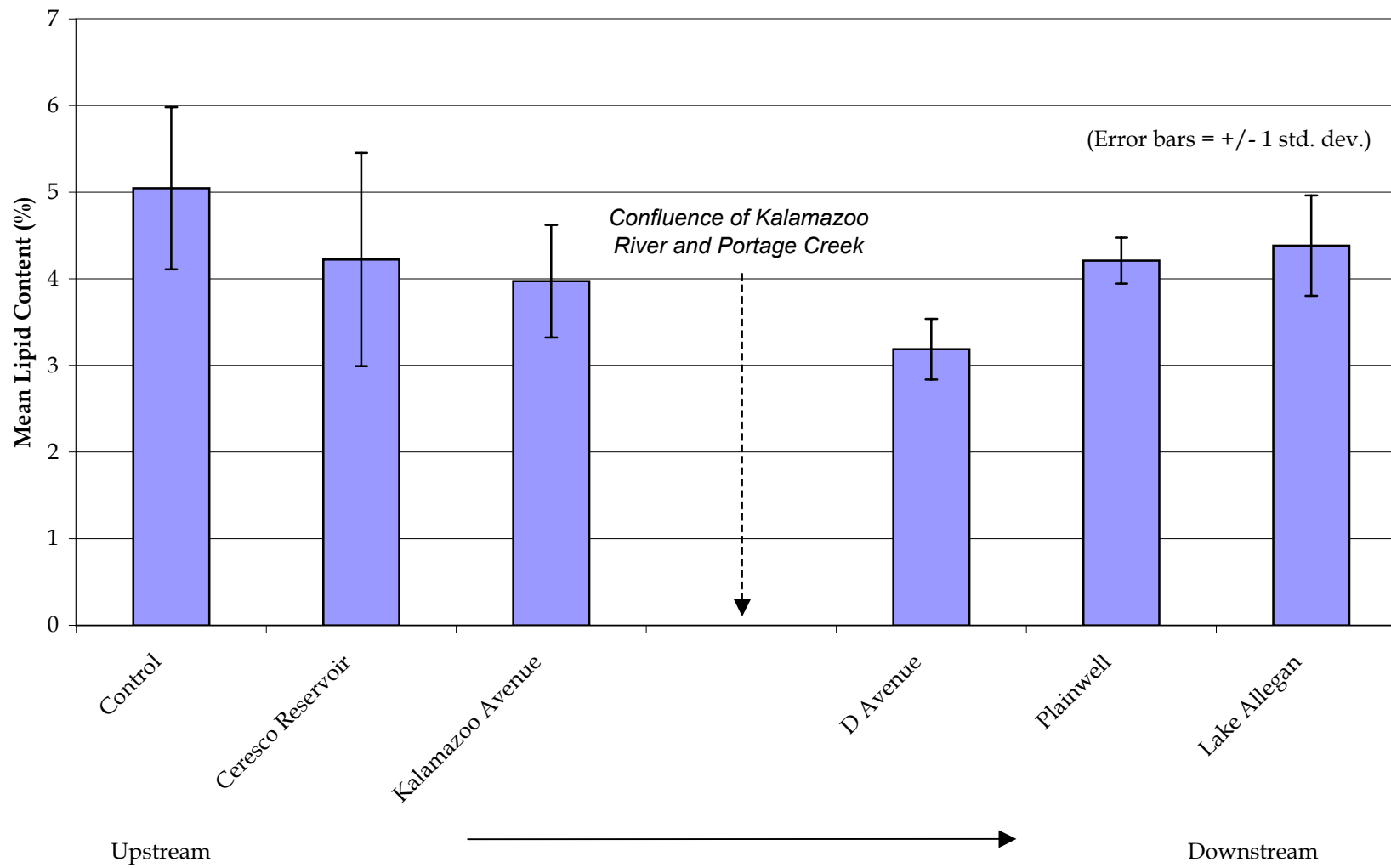


Table 3.26
Total PCB Concentrations (Congeners) and Tissue Lipid Concentrations
in Caged Yearling Channel Catfish Composites 2000

SampleID ¹	No. Fish in Composite	Total PCBs (mg/kg ww)	Lipid Content (%)	Total PCBs (mg/kg L-N)
Day 0 Samples				
CF-000-0-01	6	0.001	3.70	0.04
CF-000-0-02	6	0.009	5.74	0.15
CF-000-0-03	7	0.001	5.12	0.02
CF-000-0-04	6	0.002	5.62	0.04
Ceresco Reservoir				
CF-001-0-01	5	0.012	5.15	0.24
CF-001-0-02	5	0.008	5.40	0.15
CF-001-0-03	4	0.009	2.96	0.30
CF-001-0-04	4	0.011	3.38	0.31
Kalamazoo Avenue				
CF-067-0-01	4	0.050	4.37	1.15
CF-067-0-02	4	0.051	4.10	1.25
CF-067-0-03	4	0.073	4.40	1.66
CF-067-0-04	4	0.097	3.02	3.21
D Avenue				
CF-066-0-01	5	0.264	3.45	7.66
CF-066-0-02	5	0.221	3.08	7.18
CF-066-0-03	5	0.184	3.48	5.28
CF-066-0-04	4	0.151	2.74	5.51
Plainwell				
CF-065-0-01	6	0.171	4.43	3.85
CF-065-0-02	6	0.157	3.92	4.01
CF-065-0-03	6	0.188	4.44	4.23
CF-065-0-04	6	0.156	4.05	3.85
Lake Allegan				
CF-064-0-01	5	0.183	4.19	4.36
CF-064-0-02	5	0.215	5.23	4.12
CF-064-0-03	4	0.238	4.19	5.67
CF-064-0-04	4	0.188	3.92	4.79

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (FW-Whole Resident Fish); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is not a transect) and DD is the sequential fish number

Table 3.27
Mean Total Wet-Weight PCB Concentrations (Congeners) in
Caged Yearling Channel Catfish: Upstream to Downstream Locations

Location	Station No.	Mean Total PCBs (mg/kg ww)	Standard Deviation (mg/kg ww)	Relative Standard Deviation (%)
Day 0 Samples	--	0.003	0.004	104
Ceresco Reservoir	001	0.010	0.002	17
Kalamazoo Avenue	067	0.068	0.022	33
D Avenue	066	0.205	0.049	24
Plainwell	065	0.168	0.015	9
Lake Allegan	064	0.206	0.026	12
<i>Mean RSD (not including Day 0 samples)</i>				19

Table 3.28
Mean Total Lipid Normalized PCB Concentrations in
Caged Yearling Channel Catfish: Upstream to Downstream Locations

Location	Station No.	Mean Total PCBs (mg/kg L-N)	Standard Deviation (mg/kg L-N)	Relative Standard Deviation (%)
Day 0 Samples	--	0.06	0.06	92
Ceresco Reservoir	001	0.25	0.07	29
Kalamazoo Avenue	067	1.82	0.95	53
D Avenue	066	6.41	1.19	19
Plainwell	065	3.99	0.18	4
Lake Allegan	064	4.74	0.69	14
<i>Mean RSD (not including Day 0 samples)</i>				24

Table 3.29
Mean Tissue Lipid Concentrations in
Caged Yearling Channel Catfish: Upstream to Downstream Locations

Location	Station No.	Mean Lipid Content (%)	Standard Deviation (%)	Relative Standard Deviation (%)
Day 0 Samples	--	5.05	0.94	19
Ceresco Reservoir	001	4.22	1.23	29
Kalamazoo Avenue	067	3.97	0.65	16
D Avenue	066	3.19	0.35	11
Plainwell	065	4.21	0.27	6
Lake Allegan	064	4.38	0.58	13
<i>Mean RSD (not including Day 0 samples)</i>				15

SPMDs

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Figure 3.34. Mean Total PCBs (Congeners) in 2000 Cage Semipermeable Membrane Devices (SPMDs)
(n=3)

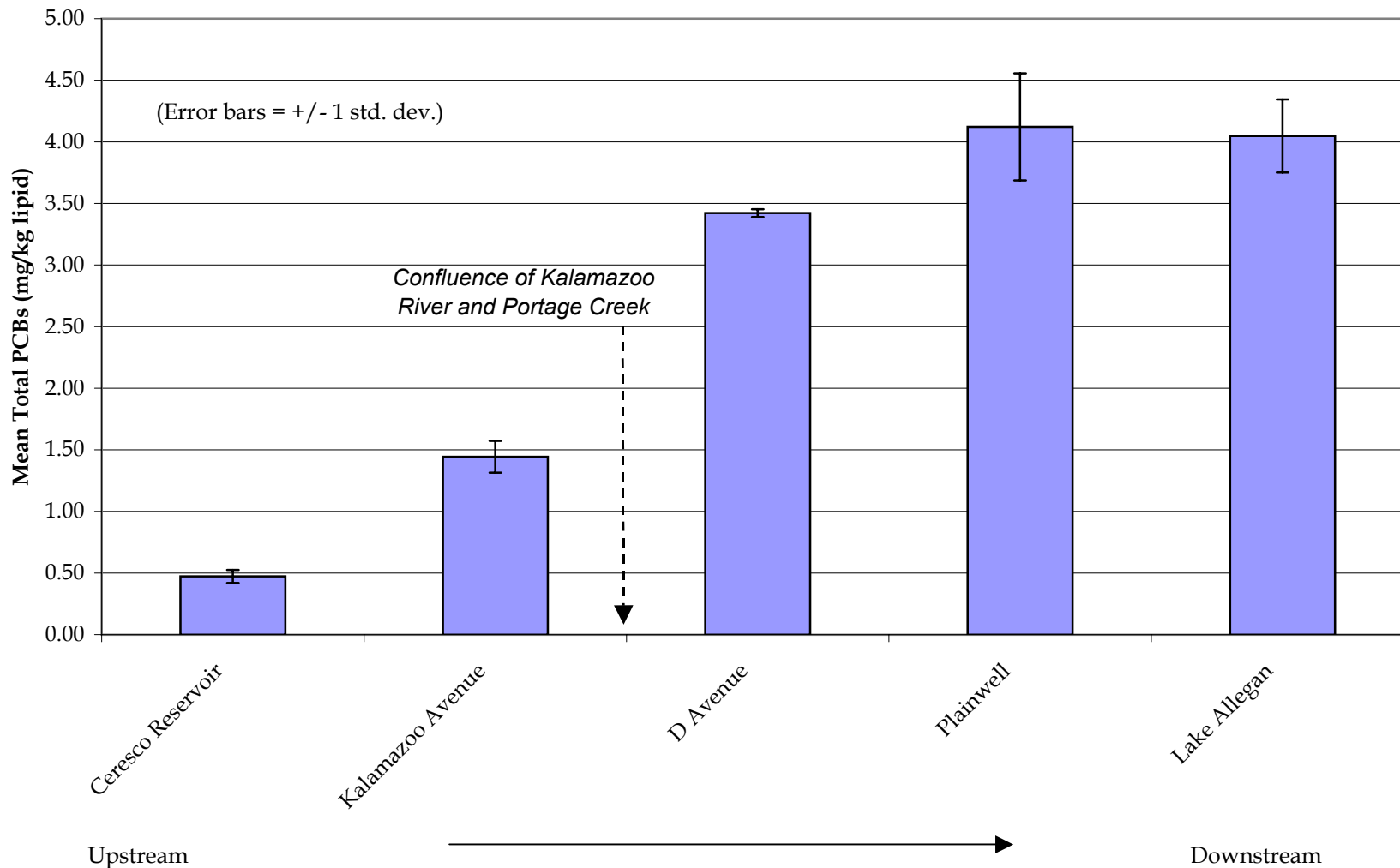


Table 3.30
Total PCB Concentrations (Congeners)
for SPMD 2000

SampleID	Total PCBs (mg/kg lipid)
Ceresco Reservoir	
SP-001-0-01A	0.53
SP-001-0-01B	0.43
SP-001-0-01C	0.45
Kalamazoo Avenue	
SP-067-0-01A	1.57
SP-067-0-01B	1.44
SP-067-0-01C	1.32
D Avenue	
SP-066-0-01A	3.46
SP-066-0-01B	3.42
SP-066-0-01C	3.39
Plainwell	
SP-065-0-01A	4.62
SP-065-0-01B	3.95
SP-065-0-01C	3.80
Lake Allegan	
SP-064-0-01A	3.71
SP-064-0-01B	4.19
SP-064-0-01C	4.24

Table 3.31
Mean Total PCB Concentrations (Congeners) in
SPMDs: Upstream to Downstream Locations

Location	Station No.	Mean Total PCBs (mg/kg lipid)	Standard Deviation (mg/kg lipid)	Relative Standard Deviation (%)
Day 0 Samples	--			
Ceresco Reservoir	001	0.47	0.053	11
Kalamazoo Avenue	067	1.44	0.129	9
D Avenue	066	3.42	0.032	1
Plainwell	065	4.12	0.434	11
Lake Allegan	064	4.05	0.297	7
<i>Mean RSD (not including Day 0 samples)</i>				8

Notes:

1. SampleID uses a 4-part nomenclature, in the following format: AA-BBB-C-DD. AA is Matrix type (SP-SPMD Sample); BBB is the sampling station identification number; C is location on transect (looking downstream, where 0 is No Transect); and DD is sample type (01-first or original sample, 02-blank, 03-duplicate)

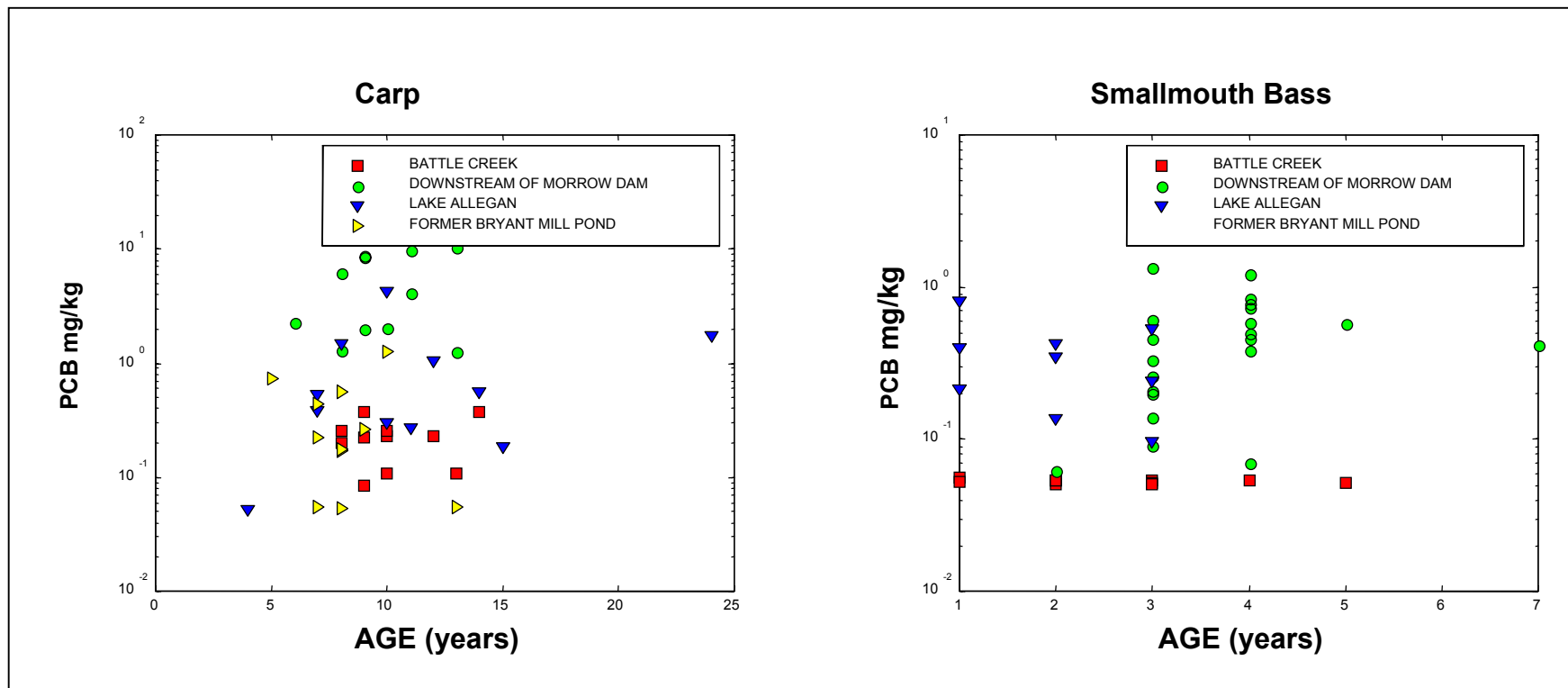
Fish Aging

Figures
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FIGURE 3.35

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
LONG TERM MONITORING PROGRAM 2000

PCB CONCENTRATION VS AGE IN CARP AND SMALLMOUTH BASS FILLETS



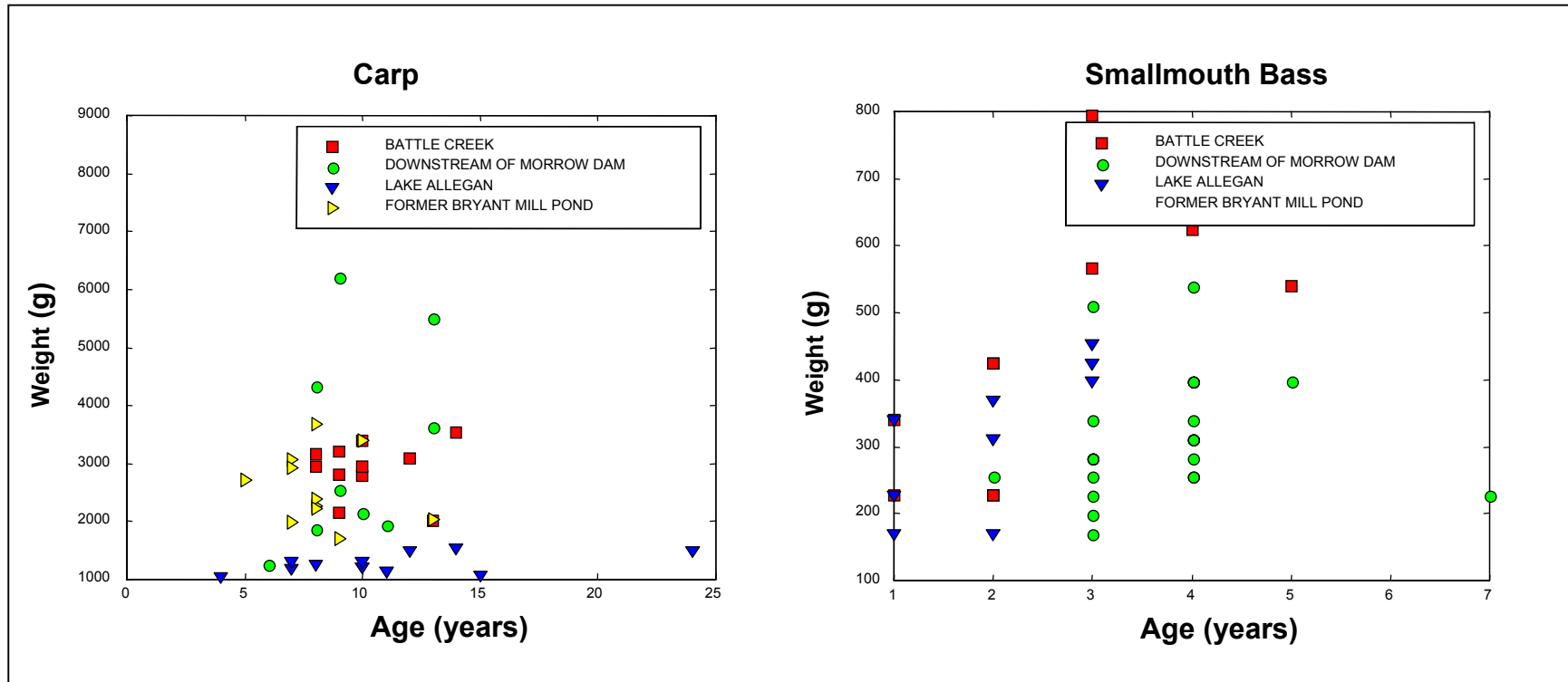
Notes:

- 1) No smallmouth bass were caught in Portage Creek at Former Bryant Mill Pond.

FIGURE 3.36

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
LONG TERM MONITORING PROGRAM 2000

FISH WEIGHT VS AGE IN CARP AND SMALLMOUTH



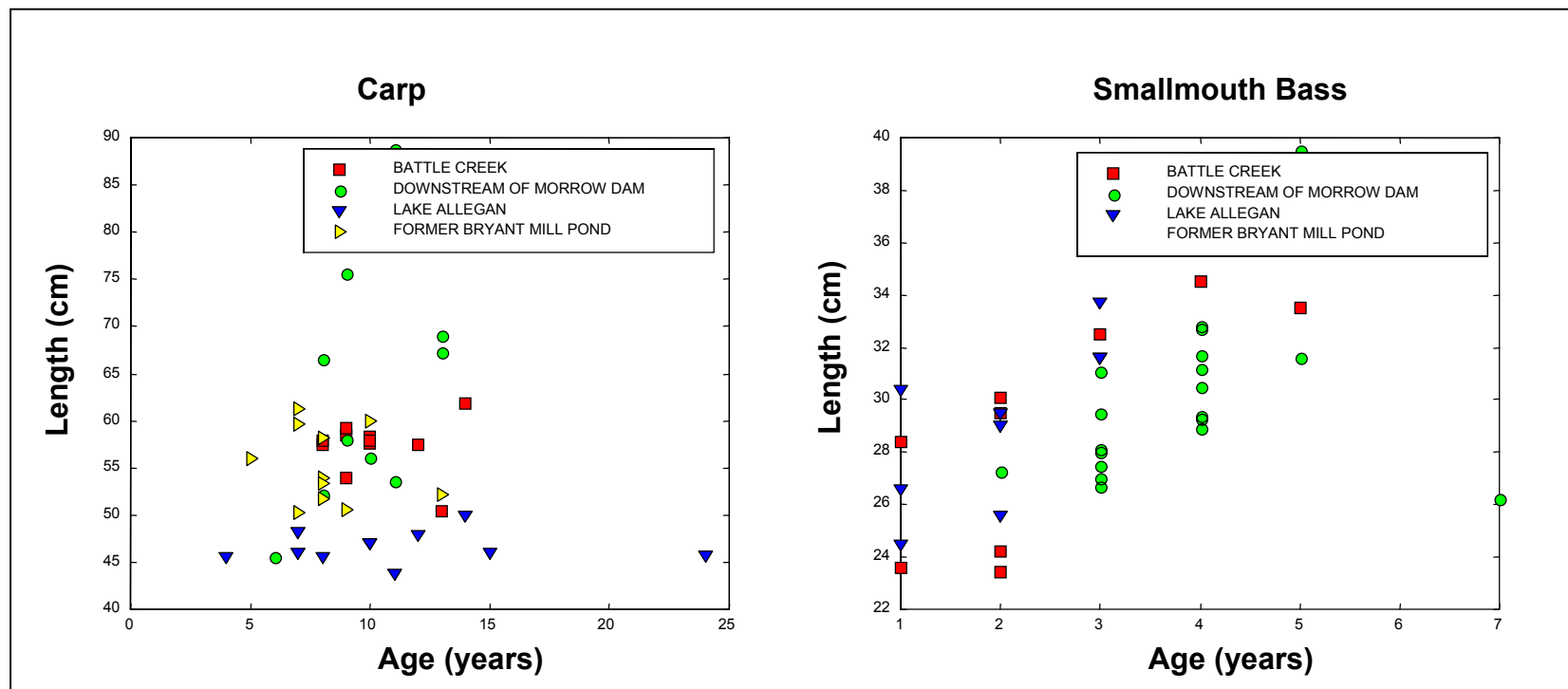
Notes:

- 1) No smallmouth bass were caught in Portage Creek at Former Bryant Mill Pond.

FIGURE 3.37

ALLIED PAPER, INC./PORTAGE CREEK/KALAMAZOO RIVER SUPERFUND SITE
LONG TERM MONITORING PROGRAM 2000

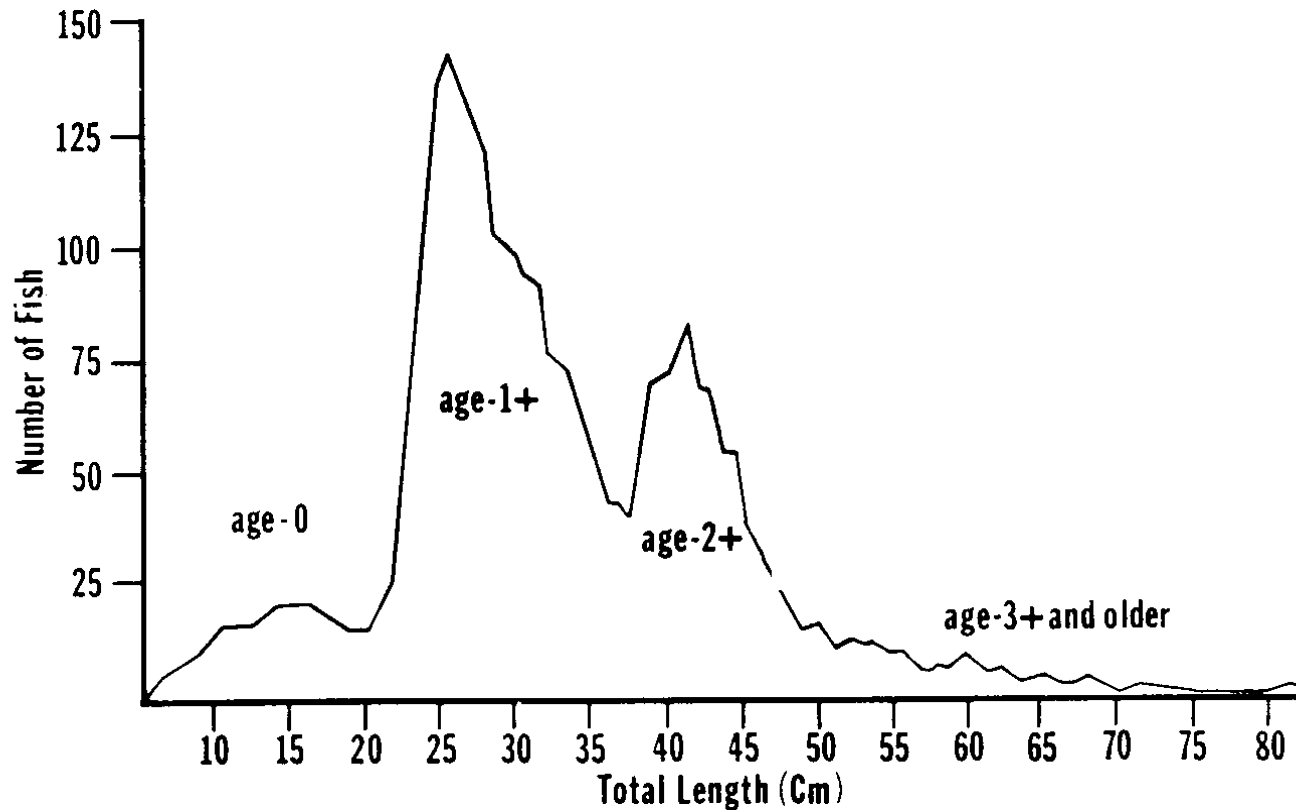
FISH LENGTH VS AGE IN CARP AND SMALLMOUTH



Notes:

- 1) No smallmouth bass were caught in Portage Creek at Former Bryant Mill Pond.

Figure 3.38. Example of Length-Frequency Distribution
Showing Different Size Groups of Fish Caught and Corresponding Year Classes



The length frequency distribution of a catch of haddock, showing the different size groups of fish caught and corresponding year classes

Table 3.32
Fish Aging Data for Smallmouth Bass

Location	Total PCBs (mg/kg ww)	% Lipids	Length (cm)	Weight (grams)	Age (years)
Ceresco	0.0522	0.248	28.4	340.2	1
Ceresco	0.0555	0.358	23.6	226.8	1
Ceresco	0.0542	0.268	30.1	425.2	2
Ceresco	0.0534	0.363	24.2	226.8	2
Ceresco	0.0536	0.445	23.4	226.8	2
Ceresco	0.0503	0.858	29.5	425.2	2
Ceresco	0.0513	0.108	38.2	708.7	3
Ceresco	0.0509	0.339	32.5	567	3
Ceresco	0.0537	0.513	38.8	793.8	3
Ceresco	0.0535	0.289	34.5	623.7	4
Ceresco	0.0512	0.164	33.5	538.6	5
Average	0.05	0.36	30.61	463.89	2.55
Lake Allegan	0.214	0.274	26.6	226.8	1
Lake Allegan	0.3998	0.406	30.4	340.2	1
Lake Allegan	0.8043	1.1	24.5	170.1	1
Lake Allegan	0.3488	0.3	25.6	170.1	2
Lake Allegan	0.137	0.356	29.5	368.5	2
Lake Allegan	0.4262	0.738	29	311.8	2
Lake Allegan	0.0965	0.249	31.6	425.2	3
Lake Allegan	0.2417	0.303	33.7	453.6	3
Lake Allegan	0.531	0.498	31.6	396.9	3
Average	0.36	0.47	29.17	318.13	2.00
Kalamazoo Ave.	0.0623	0.135	27.3	255.1	2
Kalamazoo Ave.	0.2619	0.229	26.7	170.1	3
Kalamazoo Ave.	0.2083	0.344	31.1	340.2	3
Kalamazoo Ave.	0.0915	0.433	27	226.8	3
Kalamazoo Ave.	0.139	0.559	28.1	283.5	3
Kalamazoo Ave.	0.336	0.784	27	226.8	3
Kalamazoo Ave.	0.07	0.175	31.2	340.2	4
Kalamazoo Ave.	0.3864	0.722	32.8	396.9	4
Kalamazoo Ave.	0.4959	0.816	35.9	538.6	4
Kalamazoo Ave.	0.57	0.355	31.6	396.9	5
Kalamazoo Ave.	0.4189	0.669	26.2	226.8	7
Average	0.28	0.47	29.54	309.26	3.73
D Avenue	0.201	0.322	27.5	198.4	3
D Avenue	0.4637	0.793	37.2	510.3	3
D Avenue	0.6123	1.19	29.5	255.1	3
D Avenue	1.353	2.19	28	283.5	3
D Avenue	0.5873	0.42	30.5	255.1	4
D Avenue	0.4596	0.884	29.4	311.8	4
D Avenue	0.776	1.26	28.9	283.5	4
D Avenue	0.7355	1.47	31.7	255.1	4
D Avenue	0.8503	1.52	32.7	396.9	4
D Avenue	1.208	1.66	29.3	311.8	4
D Avenue	2.347	1.06	39.5	708.7	5
Average	0.87	1.16	31.29	342.75	3.73

Table 3.33
Fish Aging Data for Carp

Location	Total PCBs (mg/kg ww)	% Lipids	Length (cm)	Weight (grams)	Age (years)
Ceresco	0.1999	2.78	57.4	3146.8	8
Ceresco	0.256	3.34	57.9	2948.4	8
Ceresco	0.0844	1.73	58.5	3203.5	9
Ceresco	0.2231	2.78	54	2154.6	9
Ceresco	0.37	4.25	59.2	2806.6	9
Ceresco	0.0636	1.37	60	3543.7	10
Ceresco	0.107	1.72	57.6	2778.2	10
Ceresco	0.2298	2.82	58.4	3401.9	10
Ceresco	0.2284	2.76	57.4	3090.1	12
Ceresco	0.109	4.79	50.4	2012.8	13
Ceresco	0.3767	5.48	61.8	3543.7	14
Average	0.20	3.07	57.51	2966.39	10.18
Lake Allegan	0.0524	0.299	45.6	1048.9	4
Lake Allegan	0.387	0.606	48.2	1304.1	7
Lake Allegan	0.5285	0.932	46	1190.7	7
Lake Allegan	1.471	0.975	45.6	1247.4	8
Lake Allegan	0.297	0.593	47.1	1219	10
Lake Allegan	4.278	0.778	47.1	1304.1	10
Lake Allegan	0.2676	0.703	43.8	1134	11
Lake Allegan	1.041	1.48	47.9	1502.5	12
Lake Allegan	0.5578	1.29	49.9	1530.9	14
Lake Allegan	0.1868	0.499	46	1077.3	15
Lake Allegan	1.738	1.54	45.7	1502.5	24
Average	0.98	0.88	46.63	1278.31	11.09
Portage Creek	0.731	2.44	56	2721.6	5
Portage Creek	0.0551	1.01	50.2	1984.5	7
Portage Creek	0.4444	1.95	61.3	3061.7	7
Portage Creek	0.2204	2.44	59.7	2920	7
Portage Creek	0.0537	1.41	54	2268	8
Portage Creek	0.1714	1.67	51.8	2381.4	8
Portage Creek	0.556	2.74	58.2	3685.4	8
Portage Creek	0.1748	4.02	53.3	2211.3	8
Portage Creek	0.2653	1.58	50.5	1701	9
Portage Creek	1.248	2.6	60	3402	10
Portage Creek	0.0545	1.46	52.1	2041.2	13
Average	0.36	2.12	55.19	2579.83	8.18
Kalamazoo Ave.	2.29	3.16	45.5	1247.4	6
Kalamazoo Ave.	1.297	3.63	52.1	1871.1	8
Kalamazoo Ave.	6.212	11.5	66.5	4337.5	8
Kalamazoo Ave.	1.969	3.66	58.1	2551.5	9
Kalamazoo Ave.	2.03	2.89	56.2	2154.6	10
Kalamazoo Ave.	4.089	5.97	53.7	1927.8	11
Average	2.98	5.14	55.35	2348.32	8.67

Table 3.33 (continued)
Fish Aging Data for Carp

Location	Total PCBs (mg/kg ww)	% Lipids	Length (cm)	Weight (grams)	Age (years)
D Avenue	8.834	13.3	80.65	8675	9
D Avenue	8.575	16.8	75.6	6208.5	9
D Avenue	9.816	17	88.9	7541	11
D Avenue	1.245	0.372	69	3628.7	13
D Avenue	10.34	21.7	67.2	5499.8	13
Average	7.76	13.83	76.27	6310.60	11.00

Section 3

Results and Discussion

The data described in this report are from the 2000 field season. General spatial and temporal distribution patterns are discussed as well as statistical analyses of results. Total PCB by congener data are discussed in this report. Resident fish samples were analyzed for PCB by Aroclor.

3.1 Surface Water Samples

Surface water samples were collected in the following surveys in 2000:

- Two dry weather events, conducted July 25-26 and October 17-22, 2000.
- One wet weather event, April 21 ("rising limb") and April 26 ("falling limb"), 2000.
- One surface water sample was collected each week during the course of the caged fish study, September 5 to October 4, 2000.

3.1.1 Dry Weather Surface Water Sample Analytical Results

The dry weather surface water sampling events were conducted at the sites identified in Table 3-1. The PCB congener results from the two dry weather events are contained in Appendices B and C. A map of the sampling stations is included as Figure 3.1. Dry weather sampling results are presented in Tables 3.1 to 3.5, and Figures 3.2 to 3.9. The daily mean discharges for the Kalamazoo River and Portage Creek, during each event, are also included in Table 3.3.

In the July sampling event (Event 1), mean total PCB concentrations in the Kalamazoo River ranged from 0.34 ng/L (State Rt. 96, King Highway Bridge) to 15.32 ng/L (26th Street Bridge, between Otsego and Allegan) (Table 3.1, Figure 3.6). Mean total PCB concentrations at the upstream background locations – Ceresco

Reservoir and Morrow Lake – were 0.51 to 1.69 ng/L, respectively. In the upper reaches of the Site – from near Comstock (at River Road Bridge) to Kalamazoo Avenue – mean total PCBs concentrations ranged from 0.34 ng/L (State Rt. 96, King Highway Bridge) to 1.43 ng/L (Kalamazoo Avenue). The mean total PCBs concentration in the reach of river between the cities of Kalamazoo and Plainwell was 2.08 ng/L. PCB concentrations between the cities of Plainwell and Allegan ranged from 6.20 ng/L to 15.32. The highest total PCBs concentration (15.32 ng/L) of all Event 1 dry weather samples was recorded in the flow from the Trowbridge Impoundment. PCBs concentrations decreased from the Trowbridge Impoundment to Lake Allegan, where the highest total PCBs concentration was 7.61 ng/L (approximately 250 feet upstream of Allegan Dam). Downstream of Lake Allegan, mean total PCBs concentrations decreased further, and ranged from 3.34 ng/L (58th St. Bridge, downstream of New Richmond) to 5.58 ng/L (Blue Star Highway Bridge, in Douglas).

In the October (Event 2) sampling event, mean total PCB concentrations in the Kalamazoo River were generally lower than Event 1, and ranged from 0.56 ng/L (Comstock) to 10.77 ng/L (Plainwell) (Table 3.2, Figure 3.6). Mean total PCB concentrations at upstream background locations, were 0.60 ng/L at Ceresco Reservoir and 1.10 ng/L at Morrow Lake. In the upper reaches of the Site, from Comstock to Kalamazoo Avenue, mean total PCBs concentrations ranged from 0.56 ng/L (River Road Bridge, near Comstock) to 5.01 ng/L (Kalamazoo Avenue). The mean total PCBs concentration in the reach of river between the cities of Kalamazoo and Plainwell was 5.47 ng/L, twice as high than was observed in the first dry weather event. The highest PCB concentration observed between the cities

of Plainwell and Allegan was 10.77 ng/L at the Plainwell Impoundment. In Lake Allegan, the mean total PCBs concentration was 1.76 ng/L (approximately 250 feet upstream of Allegan Dam). PCBs concentrations slightly increased downstream of Lake Allegan, with a mean PCB concentration of 2.36 ng/L. The highest concentration (2.99 ng/L) was at New Richmond.

The highest mean total PCB concentrations (5.24 ng/L) for all sites on the Kalamazoo River was greatest during the Event 1 sampling event. For both sampling events, the highest PCB concentrations were observed in the reach of the river between the cities of Plainwell and Allegan.

Mean total PCB concentrations at the three Portage Creek sites sampled during Event 1 ranged from 0.36 ng/L (Kilgore Road Bridge) to 15.33 ng/L (Alcott Street) (Table 3.1, Figure 3.7). During Event 2, mean total PCB concentrations at the five sites sampled ranged from 1.53 ng/L (Kilgore Road Bridge) to 6.72 ng/L (Pitcher Street) (Table 3.2, Figure 3.3). The October sample from Pitcher Street and the July sample from Alcott Street had the highest mean total PCB concentrations, at 6.72 and 15.33 ng/L, respectively.

PCB concentrations in the surface water samples collected during these two events were generally higher just downstream of the Bryant Mill Pond site located within Operable Unit-1.

Spatial Total PCB Concentration Patterns Within an Event, Across a Sampling Transect

The spatial distribution of total PCB concentrations across the sampling transects in the two individual dry weather events varied between sampling locations and events (Figures 3.2 to 3.5).

Greatest cross-transect variability was upstream of Allegan Dam (Figure 3.2) and Alcott Street on Portage Creek (Figure 3.3) sampling locations in Event 1, and at U. S. 131 at

Plainwell, and Otsego Dam in Event 2 (Figure 3.4). Cross-transect PCB concentrations varied in both events.

The spatial heterogeneity was reflected in the relative standard deviation (RSD) values, which ranged from 40 to 99 per cent (Tables 3.1 and 3.2). The mean RSD values for the dry weather events declined during the 2000 season as compared to the 1999 data: 53% for Event 1, and 40% for Event 2. The decline was not correlated with flow (Table 3.3).

Since the cross-transect variability at these locations was not consistent between events, it was difficult to identify the source (s) of the variability. Possibilities included resuspended instream sediment, eroding floodplain soils, unknown point sources, etc.

Because of the sporadically high spatial heterogeneity in total PCB concentrations across certain transects, three samples per transect will be collected in the 2001 field season, as they were in 1999 and 2000.

Total Suspended Solids

Results from the July sampling event (Table 3.4, Figure 3.8) indicate the mean TSS concentrations ranged from 4.6 mg/L (Morrow Lake) to 29.03 mg/L (Blue Star Highway bridge, in Douglas). In the October sampling event (Table 3.5, Figure 3.9), mean TSS concentrations ranged from 3.53 mg/L (Otsego Dam) to 41.53 mg/L (26th St, between Otsego and Allegan).

Locations where elevated TSS were reported did not show corresponding elevated amounts of PCBs in either July or October dry weather sampling events.

3.1.2 "Rising Limb" and "Falling Limb" Wet Weather Events

On April 21 and 26, wet weather surface water samples were collected at ten locations, as located in Figure 3.10, from the rising and falling limbs of the hydrograph, respectively. The congener results from these events are

contained in Appendix D. The analytical results are summarized in Tables 3.6 to 3.9, and Figures 3.11 to 3.14.

Total and Mean PCB Concentrations

In the rising limb, mean total PCB concentrations ranged from 0.10 ng/L (58th St Bridge, downstream of New Richmond) to 3.87 ng/L (Michigan Avenue) (Table 3.6, Figure 3.11). The highest total PCBs concentration in the rising limb was at Michigan Avenue, near Galesburg, at 11.27 ng/L. This location is upstream of Morrow Lake.

During the falling limb, mean total PCB concentrations ranged from 0.10 ng/L (all locations from Michigan Avenue near Galesburg downstream to U.S. 131 at Plainwell) to 1.12 ng/L (M-89 Bridge, Allegan) (Table 3.7, Figure 3.12). Falling limb showed non-detects from Michigan Avenue near Galesburg to U. S. 131 at Plainwell. The highest falling limb total PCBs concentration was at M-89 in Allegan, at 1.96 ng/L.

Mean PCB levels were higher during the rising limb of the hydrograph at seven of the ten sampling locations, including Portage Creek. Mean total PCB concentrations detected at the M-89 Bridge at Allegan sampling site was the same during rising and falling limbs, where as mean total PCB concentrations were lower at the remaining two sampling sites. These results are summarized in Tables 3-6 and 3-7.

Cross-transect variability was high in the rising limb, with a mean RSD of 83 (Table 3.6, Figure 3.12). Variability was lower in the falling limb, with a mean RSD of 30 (Table 3.7, Figure 3.13).

Total Suspended Solids

Mean TSS concentrations ranged from 18.33 mg/L (in Portage Creek at Bryant Street) to 81.67 mg/L (M-89 Bridge in Allegan) in the rising limb (Table 3.8, Figure 3.14). Mean TSS concentrations ranged from 11.80 mg/L (in Portage Creek at Bryant Street) to 62.33 mg/L (M-89 Bridge in Allegan) in the falling limb

(Table 3.9, Figure 3.14). Mean TSS concentrations were lower at all sampling locations in the falling limb.

Mean TSS concentrations for both rising and falling limbs increased from King Highway to M-89 in Fennville, then decreased at M-89 below Fennville and Allegan. TSS increased again at New Richmond and Kalamazoo Lake. Highest TSS for both the rising and falling limbs were at M-89 in Allegan. Of the mainstem sites, King Highway had the lowest TSS in the rising and falling limbs. However, Bryant Mill Pond, on Portage Creek, had lower TSS concentrations overall than the rest of the mainstem sites.

Cross transect variability for TSS was low, which is reflected in the lower RSDs. Both events had a RSD of 12 (Tables 3.8 to 3.9), indicating a homogeneity between sampling events.

3.1.3 Ramifications of the 2000 Water Sample Data for the 2001 Field Season

Because of the general spatial variability across many of the transects, three samples at each location will be collected for the 2001 dry and wet weather events.

3.2 Resident Fish Collections

Resident fish were collected from four locations on the Kalamazoo River and one on Portage Creek (Figure 3.15). Northeast Analytical Laboratory (NEA) analyzed fish samples for Total PCBs by Aroclor.

3.2.1 Fish Collections

Based on previous studies in the Kalamazoo River, the objectives for fish sampling at each location were:

- 11 adult carp (greater than or equal to 18 inches total length)
- 11 adult smallmouth bass (greater than or equal to 10 inches total length)

- Enough yearling smallmouth bass (2 to 4 inches standard length) to create five composite samples weighing approximately 40 to 60 grams each (typically 5 yearlings per composite).
- Selected game fish (brown trout [*Salmo trutta*], largemouth bass [*Micropterus salmoides*], and channel catfish [*Ictalurus punctatus*]) as they were available.

Length criteria for the adult fish were established in consultation with MDEQ personnel. Length criteria for the yearling smallmouth bass were derived from literature values of juvenile smallmouth bass growth rates (Carlander, 1969; Wiegmann et al., 1997)

The fish collected in 2000 (Table 3.10) generally met these criteria, with the following exceptions:

- No adult or yearling smallmouth bass were collected from the former Bryant Mill Pond area. Instead, yearling white suckers were collected.
- Ten of eleven adult smallmouth bass were collected from Lake Allegan.
- Six of eleven carp were collected at Kalamazoo Avenue and five of eleven carp at D Avenue.
- Five composites of yearling smallmouth bass were only collected at Ceresco and Lake Allegan, one composite from Kalamazoo Avenue, and no composites from D Avenue.

3.2.2 Yearling Smallmouth Bass and Yearling White Suckers

Analytical results of the yearling fish sampling are presented in Tables 3.11 to 3.14, and Figures 3.16 to 3.18. The congener results for the yearling smallmouth bass and yearling white sucker samples are contained in Appendix G.

In yearling smallmouth bass, mean total PCB concentrations ranged from 0.16 mg/kg wet-weight (w-w) (Ceresco Reservoir) to 1.30 mg/kg w-w (Lake Allegan). Mean lipid normalized (L-N) total PCBs concentrations ranged from 3.69 mg/kg L-N at Ceresco Reservoir to 41.24 mg/kg L-N at Lake Allegan. Mean lipid content ranged from 3.18% at Lake Allegan to 4.28% at Ceresco Reservoir.

In the yearling white suckers, sampled at Portage Creek, mean total PCBs concentration was 0.51 mg/kg w-w, and the mean lipid normalized total PCBs concentration was 19.91 mg/kg L-N. The mean lipid content was 2.59%.

Within-station variability of the wet-weight and lipid-normalized total PCB concentrations was low; mean RSD = 7% for the wet-weight PCBs, 10% for the lipid-normalized PCBs, and 9% for the tissue lipid values (Tables 3.12 to 3.14).

3.2.3 Adult Smallmouth Bass

Analytical results of the adult smallmouth bass sampling are presented in Tables 3.15 to 3.18, and Figures 3.19 to 3.21.

Mean total PCBs concentrations ranged from 0.05 mg/kg w-w (Ceresco Reservoir) to 0.87 mg/kg w-w (D Avenue). Mean lipid normalized total PCBs concentrations ranged from 19.28 mg/kg L-N at Ceresco Reservoir to 80.70 mg/kg L-N at D Avenue. Mean lipid content ranged from 0.36% at Ceresco Reservoir to 1.16% at D Avenue. Other observations include:

- Mean wet-weight and lipid-normalized total PCB concentrations at Ceresco were less than a third the PCB concentrations at all the other sites.
- Tissue lipid content was fairly consistent throughout the sampling sites (.360 to .475 %), with the exception of D Avenue, where lipid content was 1.16% (Figure 3.21).

Within-station variability of the wet-weight and lipid-normalized total PCB concentrations was higher in the adult smallmouth bass than in yearling smallmouth bass. The mean RSD was 49% for wet-weight PCBs, 57% for lipid-normalized PCBs and 53% for tissue lipid values (Tables 3.15 to 3.18). D Avenue had the highest wet-weight and lipid-normalized RSDs. Lake Allegan had the highest RSDs for tissue lipid concentrations. This data variability may be due to fish movement patterns. Adult fish are more mobile than yearling fish, and may have been exposed to different water and sediment PCB concentrations as they ranged through the sampling areas.

3.2.4 Adult Carp

Analytical results of the adult carp sampling are presented in Tables 3.19 to 3.22, and Figures 3.22 to 3.24.

Mean total PCBs concentrations ranged from 0.20 mg/kg w-w (Ceresco Reservoir) to 7.76 mg/kg w-w (D Avenue). Mean lipid normalized total PCBs concentrations ranged from 6.63 mg/kg L-N at Ceresco Reservoir to 111.51 mg/kg L-N at D Avenue. Mean lipid content ranged from 0.88% at Lake Allegan to 13.83% at D Avenue. Other observations noted:

- Mean wet-weight total PCB concentrations at Ceresco were more than four times less than the PCB concentrations from Kalamazoo Avenue to Lake Allegan, where PCB concentrations ranged from .98 to 7.76 mg/kg wet weight.
- Mean lipid-normalized total PCB concentrations at Ceresco were at least half or less than all the other sites.

Within-station variability of the wet-weight and lipid-normalized total PCB concentrations was higher in adult carp than in the yearling or adult smallmouth bass, with a mean RSD of 78% for wet-weight PCBs, 78% for lipid-normalized PCBs and 50% for lipid values (Tables 3.20 to 3.22). Lake Allegan had the

highest RSDs for both wet-weight and lipid-normalized samples. RSDs for tissue lipid concentrations were highest for Kalamazoo Avenue and D Avenue.

The variability of the data may be due to fish movement within reaches. Adult carp are more mobile than adult smallmouth bass (R. Day, MDEQ, personal communication).

3.2.5 Other fish

Seven other fish were collected from a total of three sampling sites (Table 3.23; Figures 3.25 to 3.27). Fish were generally predatory species and game fish. These species were collected to examine different trophic levels, and for potential use for Human Health Risk Assessment.

Total PCBs concentrations ranged from .05 mg/kg w-w (rock bass at Kalamazoo Ave and brown trout at Portage Creek) to 1.80 mg/kg w-w (walleye at Lake Allegan). Lipid normalized total PCBs concentrations ranged from 6.55 mg/kg L-N (brown trout at Portage Creek) to 130.83 mg/kg L-N (northern pike at Kalamazoo Ave). Lipid content ranged from .33% in the northern pike at Kalamazoo Avenue to 1.65% in the walleye at Lake Allegan.

3.2.6 Bedded Sediment

Composite samples of the upper 2 inches of bedded sediment were collected at Kalamazoo Avenue, Portage Creek and D Avenue resident fish sampling locations. Analytical results are presented in Table 3.24 and Figure 3.28. Total PCB concentrations ranged from 0.205 mg/kg wet weight at Kalamazoo Avenue, .054 mg/kg w-w at the former Bryant Mill Pond area, and .177 mg/kg wet weight at D Avenue (Table 3.24 and Figure 3.28). The congener results for the sediment samples associated with the 2000 resident fish collections are contained in Appendix H.

Sediment PCB concentrations were moderately correlated with PCB concentrations in the

yearling smallmouth bass and carp, and only weakly correlated with PCB concentrations in adult smallmouth bass. It should be noted that while these samples were intended to be representative of the sediments where resident fish were collected, they are not necessarily representative of either the sediments to which the fish may have been exposed during their life spans, or of the larger reach these fish were intended to represent. Fish and sediments were usually collected from near-shore areas; shore-side log jams, rock or rip-rap deposits, near boat docks, etc.

3.3 Caged Fish and SPMD Study

From September 4 to October 4, 2000, caged channel catfish and SPMDs were placed at five locations (Figure 3.29), to evaluate the utility of using these as potential indicators of short-term, site-specific bioavailable PCBs. Surface water samples were collected when the caged catfish and SPMDs were deployed and after seven, 14, 21, and 28 days of exposure.

Analytical results are presented in Tables 3.25 to 3.31, and Figures 3.30 to 3.34. The congener results for the cage study water samples are contained in Appendix H; caged channel catfish samples, Appendix I; and caged SPMD samples, Appendix J.

3.3.1 Caged Fish Surface Water Samples

The mean total PCB concentrations for the caged fish surface water samples ranged from 0.22 ng/L at Ceresco Reservoir to 13.93 at Plainwell (Table 3.25, Figure 3.30).

The spatial distribution of total PCB concentrations in the surface water samples collected during the cage study was fairly consistent during the 28-day exposure period, and was also similar to the patterns observed in the 2000 dry weather sampling surveys (Section 3.1.1). Specifically:

- PCB concentrations in surface water were lower from the Ceresco Reservoir, compared to those at downstream caged fish locations.
- PCB concentrations in the Kalamazoo River increased from D Avenue to Plainwell, then decreased slightly at Lake Allegan.

3.3.2 Caged Fish

The mean total PCBs concentrations for caged yearling channel catfish ranged from 0.010 mg/kg w-w at Ceresco Reservoir to 0.206 mg/kg w-w at Lake Allegan (Tables 3.26 and 3.27; Figure 3.31). Mean lipid normalized total PCBs concentrations ranged from 0.25 mg/kg L-N at Ceresco Reservoir to 6.41 mg/kg L-N at D Avenue (Tables 3.26 and 3.28; Figure 3.32). Mean lipid content ranged from 3.19% at D Avenue to 4.22% at Ceresco Reservoir (Tables 3.26 and 3.29, Figure 3.33).

The spatial distribution of total PCBs in the channel catfish, both wet-weight and lipid-normalized, had similar trends to the PCBs in the water samples, with a few variations:

- PCB concentrations were lowest in the Ceresco Reservoir.
- PCB levels increased at Kalamazoo and D Avenues, decreased slightly at Plainwell and increased again at Lake Allegan.

3.3.3 SPMDs

The mean total PCBs concentrations for SPMDs ranged from 0.47 mg/kg lipid at Ceresco Reservoir to 4.12 mg/kg lipid at Plainwell (Tables 3.30 and 3.31; Figure 3.34).

3.4 Fish Aging

The average age of carp caught during the 2000 Long Term Monitoring program was approximately 10 years, whereas, the average smallmouth bass age was 3.7 years. The oldest smallmouth bass and carp collected in 2000 were approximately 7 and 24 years old, respectively.

Figures 3.36 and 3.37 show the relationship between age/weight, and age/length, for carp and smallmouth bass, respectively. Carp do not show any relationship between age and weight ($r^2 = 0.00002$) or length ($r^2 = 0.0004$). Whereas, smallmouth bass demonstrate a better relationship between age and weight ($r^2 = 0.0725$) and length ($r^2 = 0.1679$) than carp. However, neither weight or length can be used to determine true estimates of fish age. Some of the fish estimated to be 1 year old (Table 3.32) from Lake Allegan and Ceresco Reservoir are longer (>23 cm) than typically observed for 1 year old fish (8-17 cm) (Trautman 1981). Environmental factors (i.e. prey availability, water quality conditions) can affect the growth of a fish. The reason for large year-old fish in these two waterbodies is not understood.

Fish aging results demonstrated that there were little to no relationship between the age of a fish and the levels of total PCBs in their tissue (Figure 3.35). That is, older fish do not necessarily have higher concentrations of PCB. This was particularly true for carp. A carp from Lake Allegan was aged to be 24 years only had 1.7 mg/kg of total PCB in it's tissue, while a ten year old fish from Lake Allegan had 4.3 mg/kg of PCBs in tissue (Tables 3.32 and 3.33).

Because fish age did not correlate well with PCB concentration with one years worth of data, fish will be aged from those collected in 2001. The resulting data may then be adequate to use in length-frequency distribution analysis to determine age class based upon length. The length-frequency distribution would be calculated for both smallmouth bass and carp using length data collected from these species since 1993. A length-frequency distribution may show recognizable peaks for various size distributions, upon which age can be estimated (Figure 3.38, an example) (Nielsen, et.al 1985).

3.5 Summary of Field QC

Field QC is primarily used to evaluate the sampling protocol. Based on a review of the

analytical data, field duplicates were collected at the prescribed frequency for events with the exception of 3 bedded sediment samples collected in late August (Bryant Mill Pond, Kalamazoo Avenue) and September (D Avenue, Lake Allegan, and Ceresco) 2000. These deviations from the sampling plan do not affect the usability of the data. Field duplicate samples were not collected for fish or semi-permeable membrane samples due to the nature of these matrices.

The RPD between field samples and field duplicates varied greatly for all the sampling events and matrices. As mentioned at the beginning of Section 2. 5. 2, an RPD of 25% or less is the guideline for acceptable agreement between field sample and field duplicate. However, several factors, such as sampling technique, homogeneity of the sample matrix and contaminant concentration, influence the RPD of field duplicate samples, so data are not qualified based on an exceedance of the 25% RPD guideline. In general, low PCB concentration surface water samples had high RPDs, often approaching 200%. This is because non-detect samples were being compared with very low concentration field duplicates. Higher concentration surface water samples showed better agreement for field duplicates, as did the sediment samples. In some cases where instream water samples were collected, sampling technique may have contributed to the high RPDs seen for some sampling events.

MS/MSD sampling

Matrix spike and matrix spike duplicate (MS/MSD) sample collection was adequate for the bedded sediment sampling conducted July 20, 2000 (one per 15 samples).

MS/MSD sample collection for all other 2000 LTM sample collection events did not conform to the planned frequency of one per 20 samples. The dry weather, wet weather and caged fish surface water sampling events did not collect the extra volume needed for MS/MSD analysis. This constitutes a data gap and requires

corrective action. The recommended action is to identify MS/MSD locations prior to the field-sampling event based on knowledge of the sampling locations. This will help ensure that sufficient volume will be available for these samples. This data gap does not affect the usability of the 2000 data, however. The matrices being sampled have been sampled several times previously and the laboratory has reported little or no matrix interference. In addition, MS/MSD samples will be taken in 2001 to confirm again there is no matrix interference.

MS/MSD samples were not collected for the SPMDs due to the nature of the matrix. The laboratory did conform to the recommended frequency of one MS/MSD per 20 fish samples.

Blanks for water sampling

Based on the review of the field blank data for the 2000 Long Term Monitoring, it was noted that liquid field blanks collected after the April sampling events began showing low level detections of PCBs. While these PCB detections did not result in data qualification for the sampling events this year, the source of the PCBs should be investigated. The laboratory blanks for these sampling events were acceptable and often sample sets had several samples with no detections of total PCB so laboratory contamination of the field blanks is unlikely. The levels of PCB in the sample matrices being collected are very low so transfer of PCB via sampling equipment is also unlikely. The likely source of the low-level PCB in the field blanks is the source water for the field blanks. Field personnel report using ultra-pure distilled water for the field blanks for the first few sampling events of the 2000 sampling year. Prior to the July dry weather sampling, the source of field blank water was changed to distilled water purchased from a local store. Based on the data, it appears that this grade of water is not sufficiently pure to be used for field blanks for PCB. The recommended corrective action is to change the source for liquid field

blank water to ultra-pure or laboratory reagent grade distilled water for all future sampling events.

Wet weather sampling

The wet weather sampling event conducted on April 21, 2000 (rising limb) conformed to the prescribed blank frequency with 3 field blanks collected for 30 samples. Non-detect PCB congeners were recorded for each of the three rinsate blanks.

Two rinsate blanks were collected per 30 samples, for the wet weather sampling event conducted on April 26, 2000 (falling limb). This does not conform to the prescribed duplicate collection frequency. PCB congeners were not detected in either of the rinsate blanks.

Dry weather sampling, July 25 and 26, 2000

For the July 25, 2000 dry weather surface water survey, two rinsate blanks were collected for 33 samples. This frequency did not conform to the prescribed frequency of one rinsate blank per every ten samples. Both field blanks had total PCB detections, 0.606 and 2.98 parts per trillion, however neither blank had any congener detections greater than the PQL, therefore, no data were flagged.

Two rinsate blanks were collected for 28 samples for the dry weather sampling of July 26, 2000. This frequency did not conform to the prescribed frequency of one rinsate blank per every ten samples. Both field blanks had total PCB detections, 0.49 and 4.05 parts per trillion, however neither blank had any congener detections greater than the PQL, therefore, no data were flagged.

Dry weather sampling, October 17 to 22

Two rinsate blanks were collected for 65 samples during the dry weather sampling event of October 17 through October 22, 2000. This frequency did not conform to the prescribed frequency of one rinsate blank per every ten samples. Both field blanks had total PCB detections, 2.56 and 1.3 part per trillion,

however neither blank had any congener detections greater than the practical quantitation limit therefore no data were flagged based on these rinsate blanks.

Caged catfish, water sampling

No field blanks were collected for the caged fish water sampling conducted September 5, 2000 where 5 surface water samples were collected. Two field blanks were collected for the caged fish water sampling conducted on September 13, 20 and 27, 2000. Twenty-five samples were collected for this event so the blank frequency is acceptable. Both field blanks had total PCB detections, 0.91 and 0.73 parts per trillion, however, neither blank had any congener detections greater than the practical quantitation limit so no data were flagged based on these rinsate blanks.

Resident fish, bedded sediment sampling

No field blanks were collected for the 3 bedded sediment samples collected in late August (Bryant Mill Pond, Kalamazoo Avenue) and September (D Avenue, Lake Allegan, and Ceresco) 2000.

3.6 Summary of Laboratory QC

Wet weather sampling

The data summary information for the April 21, 2000 wet weather surface water sampling survey met all QC criteria for check standards, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. The two field duplicates collected were outside the control criteria of 25% for field duplicates, however no data were qualified based on the deviations. Based on the QC information, the April 21, 2000 wet weather “rising limb” surface water data are usable as reported by the laboratory.

The data summary information for the April 26, 2000 wet weather “falling limb” surface water sampling survey met all QC criteria for check standards, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries.

One of the four field duplicates was outside the control criteria of 25% for field duplicates, however, no data were qualified based on this deviation. Based on the QC information, the April 26, 2000 wet weather surface water data are usable as reported by the laboratory.

Dry weather sampling, July 25 and 26, 2000

The data summary information indicates that the July 25, 2000 dry weather surface water sampling survey had all surrogate recoveries in control, all lab blanks in control, and all check standards and lab control spikes in control. No MS/MSD sample was collected for this event. The two sets of field duplicates were outside the control criteria of 25% for field duplicates. One set of duplicates had a non-detect for PCB and a low level detection, which calculates to a 200% relative per cent difference. The other set of field duplicates had a 194% relative per cent difference because the sample showed a low level of PCB at 1.13 ppt and the duplicate showed a relatively high level of PCB at 70 ppt. This could be due to the sample collection technique, which requires the sample and duplicate be collected separately in order to collect sufficient volume. No data were qualified based on this deviation based on the fact that all the laboratory QC was in control, the July 25, 2000 dry weather surface water data are usable as reported by the laboratory.

The data summary information indicates that the July 26, 2000 dry weather surface water sampling survey had all surrogate recoveries in control, all lab blanks in control, and all check standards and lab control spikes in control. No MS/MSD sample was collected for this event. The two field duplicates were within the control criteria of 25% for field duplicates. Based on the QC information, the July 26, 2000 dry weather surface water data are usable as reported by the laboratory.

Dry weather sampling, October 17 to 22, 2000

The data summary information indicates that the October 17 through October 22, 2000 dry weather surface water sampling survey had all surrogate recoveries in control, all check standards and lab control spikes in control. No MS/MSD sample was collected for this event. Two of the four laboratory blanks samples were outside the control criteria for total PCB. This may or may not result in qualification of the analytical data associated with the blank, as data are qualified on a congener specific basis and the individual congener values in the laboratory blank may exceed the QC criteria. The data in the effected samples would be qualified by the laboratory as a result of any congener specific blank QC violations. These two laboratory blanks did not contain congener concentrations greater than the laboratory QC criteria so no data were qualified. The field duplicate was outside the control criteria of 25% for field duplicates. Based on the laboratory QC information, the October, 2000 dry weather surface water data are usable as reported by the laboratory.

Caged catfish sampling

The data summary information for the September 5, 2000 caged fish surface water sampling survey indicate acceptable QC for all check standards, laboratory control spikes, and surrogate recoveries. One of the laboratory blanks for this survey contained total PCBs greater than the PQL, however no individual PCB congener concentrations exceeded the PQL so no data were qualified. No MS/MSD sample was collected for this event. The field duplicate was outside the control criteria of 25% for field duplicates. Based on the QC information, the September 5, 2000 caged fish surface water data are usable as reported by the laboratory.

The data summary information for the September 13 and October 4, 2000 caged catfish surface water sampling survey indicates acceptable QC for all check standards,

laboratory control spikes, laboratory blanks and surrogate recoveries. No MS/MSD sample was collected for this event. The field duplicate was outside the control criteria of 25% for field duplicates. Based on the QC information, the September 13 and October 4, 2000 caged fish surface water data are usable as reported by the laboratory.

The caged catfish sampling conducted September 5, 2000 indicated acceptable QC for laboratory blanks and laboratory control spikes. However, all the surrogates were out of control for the samples and laboratory QC. Based on review of the spike recovery concentrations this is likely due to the probable double spiking of the samples. Because there is no way to verify this after the fact, all caged fish data should be considered estimated and qualified with a "J" qualifier for total PCB concentration. These data are usable with the "J" qualifier.

As part of the September 5, 2000 caged catfish study, semipermeable membrane devices were used. The data summary information for the semipermeable membrane device samples collected October 4, 2000 indicate acceptable QC for all check standards, laboratory blanks and laboratory control standards. Due to the nature of this matrix, no surrogates or MS/MSDs are performed.

The data summary information for 20 caged yearling catfish samples analyzed for PCB congeners indicate acceptable QC for all check standards, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. A control carp was used for the laboratory control spike for this batch. This carp is a ground whole fish certified reference material prepared by the National Research Council Canada. The results of the control carp analysis indicated that all recoveries of spiked compounds were within the control limits set by the Council for this reference fish. Several PCB congeners were removed from the samples due to co-elution

with unknowns in the sample matrix. The data does not require any qualification due to the interference detected. Based on the QC information, the channel catfish data are usable as reported by the laboratory.

Resident fish

The data summary information for 12 resident fish samples collected August 10, 2000 (carp and one brown trout from former Bryant Mill Pond) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. All detections of Aroclors 1242 and 1254 and all but one detection of Aroclor 1260 were flagged by the laboratory as exhibiting an altered PCB pattern and are reported as a best Aroclor match. Based on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 18 resident fish samples collected August 28, 29, and 30, 2000 (smallmouth bass and carp from Kalamazoo Avenue) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. All detections of Aroclors 1242, 1254, and 1260 were flagged by the laboratory as exhibiting an altered PCB pattern and are reported as a best Aroclor match. Based on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 14 resident fish samples collected August 31, 2000 (carp and smallmouth bass from D Avenue) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. All detections of Aroclors 1242 and 1254 were flagged by the laboratory as exhibiting an altered PCB pattern and are reported as a best Aroclor match. Based

on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 2 resident fish samples collected August 31, 2000 (carp from D Avenue) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, and laboratory blanks. The surrogate recovery for all samples, blanks and LCS were in control but the surrogate recovery for the MS/MSD samples were out of control. The spike recovery and agreement between spike and spike duplicate was acceptable so no data were qualified as a result of the out of control surrogates. All detections of Aroclors 1242, 1254, and 1260 were flagged by the laboratory as exhibiting an altered PCB pattern and are reported as a best Aroclor match. Based on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 11 resident fish samples collected September 19, 2000 (carp from Lake Allegan) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. All detections of Aroclors 1242 and 1254 and several detections of Aroclor 1260 were flagged by the laboratory as exhibiting an altered PCB pattern and are reported as a best Aroclor match. Based on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 15 resident fish samples collected September 18, 19 and 20, and November 16, 2000 (smallmouth bass and other species from Lake Allegan) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. All detections of Aroclors 1242 and 1254 were flagged by the laboratory as exhibiting an altered PCB pattern and are

reported as a best Aroclor match. Based on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 11 resident fish samples collected September 21, 2000 (smallmouth bass from Ceresco) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. No PCB Aroclors were detected in this batch of samples. Based on the QC information, the resident fish data are usable as reported by the laboratory.

The data summary information for 9 resident fish samples collected September 21, 2000 (carp from Ceresco) and analyzed for PCB Aroclors, indicate acceptable QC for all continuing calibration, laboratory control spikes, laboratory blanks, MS/MSDs and surrogate recoveries. All detections of Aroclor 1254 were flagged by the laboratory as exhibiting an altered PCB pattern and are reported as a best Aroclor match. Based on the QC information, the resident fish data are usable as reported by the laboratory.

3.6.1 Recommendations for Corrective Actions

Several deficiencies were noted regarding field QC sample collection for the 2000 Long Term Monitoring year. The first being insufficient MS/MSD samples for surface water and sediment samples and the second being concentrations of total PCB in field blank samples that were occasionally higher than the PCB concentration in samples. The following are suggested corrective actions that should be reviewed with the intent to implement the most appropriate actions into the subsequent sampling events conducted under the Long Term Monitoring Plan. All corrective actions to be implemented have been documented into the SOP for 2001 and 2003.

Matrix Spike/Matrix Spike Duplicate Collection
The recommended corrective action to help ensure sufficient MS/MSD sample collection in the field for subsequent sampling events is to identify MS/MSD locations prior to the field-sampling event based on knowledge of the sampling locations. Once identified, sample numbers and bottle labels should be prepared in advance to cue the field sampling personnel about the need to collect extra sample volume for the MS/MSD at these particular locations. This will also help ensure that a frequency of one MS/MSD per 20 samples is collected and that sufficient volume will be available for these samples.

Upon completion of an additional sampling year (2001) of MS/MSD information for surface water and sediment, it would be appropriate to consider the need for MS/MSD analysis in future sampling events. At that point in the study, the matrices being sampled will have been sampled several times. If little or no matrix interferences are reported by the laboratory for these matrices it would be acceptable to discontinue MS/MSD analysis as it would not be providing any additional information. It is however recommended that MS/MSD analysis continue for the fish matrix because it is a more difficult matrix to analyze. It would be necessary for the laboratory to perform their Laboratory Control Spike in duplicate for each sample batch that does not contain an MS/MSD so that there is a measure by which to evaluate the precision of the data. Any deviation from the original Long Term Monitoring Plan must be documented in writing as an addendum to the Plan.

Field Blank Collection

The recommended corrective action is to change the source for liquid field blank water to ultra-pure or laboratory reagent grade distilled water for all future sampling events. It would be appropriate to request a certification of the water with information regarding PCB content.

This will help to ensure that detections of PCB in field blanks should be below the laboratory PQL in most cases. This is necessary because the purpose of the field rinsate blank is to evaluate the field decontamination and sample handling procedures. When the source water is not sufficiently pure, this evaluation can not be performed.

Section 4

Plans for the 2001 Field Season

Based upon the results of the year 2000 sampling events, the following activities are proposed for the Long-Term Monitoring Plan for Year 2001.

- Three dry weather surface water sampling stations will be added in 2001, for a total of 17 stations.
- Three wet weather surveys will be conducted at 14 stations. These will consist of spring, summer and fall sampling.
- An Inlet/Outlet study will be conducted to assess the fate of PCBs at Lake Allegan and Morrow Pond, to evaluate the lake's role as a sink or source of PCBs to downstream portions of the river, and to evaluate seasonal variations in PCB loading. Surface water samples will be collected monthly at inlet and outlet areas of each impoundment.
- In addition to the resident fish and yearling fish collections, catfish will be collected, as available, as these are a primary target for many fishermen. Additionally, for Portage Creek, yearling carp will be collected in 2001.
- Cage studies with channel catfish will be conducted at 14 sites, and SPMDs at five sites.

The results from the 1999, 2000 and 2001 sampling years will be collectively evaluated to determine/confirm the data requirements for the final year of baseline data collection effort.

The next stage in sampling for the long term monitoring program is planned for 2003. However, sampling will be conducted in 2002 to fill collect data not collected in 2001 (e.g. wet weather event).

Section 5

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